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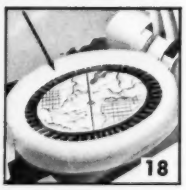

AUGUST 1966 VOLUME 12 NUMBER 8

Letters 1
Helicopter Crystal Ball, William H. Smith 2
Misery Knows My Company, Lt James L. George 9
Maintenance and the Mountains, Capt Willard L. Wiard 10
The Mechanic's Challenge—ZD 12
Bat-Turn, Lt Ronald M. Altman 14
Individualism and Professional Pride, Capt William E. Keller 16
Development of AAAIS, Willis A. Dworzak 18
Let's Standardize, Capt Clarence O. Bakken 22
Successful Flight Instructors, Jack S. Harrison 23
Armed CH-47A Helicopter Employment, Lt Col Morris G. Rawlings (Ret) 26
How Do You Use Your Aviation Safety Officer? Maj William J. Lumpkins 29
Aviation Career Course, Maj Ernest E. Varney, Capt Arlie Deaton and Lt James W. Martin 30
Engineering Approach to Light Twin Operation, John Paul Jones 33
Crash Sense 42
Army Aviation School Nonresident Instruction Inside Back
Weight and Balance Back

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

The DIGEST is an official Department of the Army periodical published monthly under the supervision of the Commandant, U. S. Army Aviation School. Views expressed herein are not necessarily those of Department of the Army or the U. S. Army Aviation School. Photos are U. S. Army unless otherwise specified. Material may be reprinted provided credit is given to the DIGEST and to the author, unless otherwise indicated.

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LETTERS

Sir:

Reading the first two letters in your April 66 issue from SAC and the USN prompts me to wonder if people realize just how widely read your magazine is. For instance, it is distributed in British Army aviation units worldwide where it is read with more avidity than any other publication, with the possible exception of Playboy (praise indeed!).

• • •

We believe that your Digest contains more horse-sense per page than any other aviation publication...

MAJ J. CULLENS
3 Flight Army Air Corps
Kapit, Borneo
British Forces Post Office 685

Sir:

In the letters section of the May issue Captain Walter Bragg wrote of difficulties in issuing survival equipment.

I feel it is time Army Aviation gets serious with itself and its medical-safety program or else quit carrying on this silly game of make believe. Army Aviation now has more pilots than the Air Force and Navy combined, yet we are far behind either in our safety and pilot care program.

Recently I spent several days on a search and rescue mission for a downed helicopter near Savannah, Georgia. A farmer found the aircraft five weeks later in an area that was crossed and re-crossed many times in the search operations. Yet when the flight surgeon recently suggested that aviators at this post be issued individual survival kits the response was much the same as that experienced by Captain Bragg—a horse laugh.

In the same May issue an article appeared concerning the aircraft first aid kit. I dare say that ninety percent of our aviators do not know what is in that kit.

What is the solution to the problem? At least one that seems obvious to many of us stands out. The key person around which medical-safety programs revolve in aviation is the flight surgeon. I have yet to find an aviator who is not all for the flight surgeon and generally abides with his recommendations. It is the flight surgeon who should know best the medical aspects of survival. It is the flight surgeon who should be responsible for setting up short periodic instruction sessions for the aviators that would cover such areas as the first aid kit, fatigue, nutrition, and many other related pertinent subjects.

It is a sad day for aviation medicine when we have to apologize to aviators from the other branches, as I had to recently, for the lack of time we have to spend with them and their problems because we are busy caring for other personnel first.

Until command level accepts the fact that aviators have special problems (and are not equivalent to "truck drivers" as one commander has indicated) and utilizes one of its key assets, namely its flight surgeon, in solving these problems the Army Aviation safety and general pilot care program will remain in the "flying Jenney" era.

CAPT ROY D. KENT
MC/AMO
Fort Benning, Ga.

Sir:

Cheers to Lt Col Dickens for his fine article on the "Otter" in your May edition. There is only one additional comment I would like to make and that is in behalf of the "youngsters" who are now flying a large portion of the Otter missions. I refer to the junior Warrants, fresh out of flight school, U-1A transitioned at Fort Ord, and sent directly to Vietnam. They have proven to be highly capable, resourceful, and militarily dependable individuals. They have fastly become the backbone of the Otter world in Vietnam. Whoever pushed getting these young, energetic people into the flying program should be given a medal.

MAJ STEPHEN FARISH
54th Aviation Company
APO San Francisco 96291

Sir:

Reference US Army Aviation Digest, April 1966, Volume 12, Number 4, back cover article titled "Fixation."

The last paragraph of the article—"The one positive action we can take to fight channelized attention, or fixation, is to recognize it, discuss it, be ready for it. Question your thoroughness when you are in a tight . . . Is there something I've left out?"

Fixation, according to Webster, is an obsessive preoccupation; undergoing arrestment at a stage of development—in other words, a mental block, the inability to reason and logically conclude.

"Question your thoroughness when you are in a tight . . ." How can you possibly expect systematic mental processes to develop, to analyze, to compare, to sort, to reason, to logically conclude—and respond with the correct solution—". . . when you are in a tight . . ." when you don't even realize that you are in the depths of fixation, unable to reason and logically conclude?

I agree, fixation was recognized in the article—and it was discussed well as Sunday morning quarterbacking—"The accident board immediately recommended that the bold face emergency procedures be changed to require crews to switch to the fullest tank *when the engine quits.*" Why not require the copilot to sit with one hand constantly on the fuel selector? At least the "quit time" would be reduced, assuming the copilot's reactions were sufficiently fast.

Actually, why wait until the engine quits from fuel starvation? Why risk additional accidents, loss of aircraft, and possibly loss of lives? You agree that the proposed change to the emergency procedures "would help only if the crew is not deeply submerged in a fixation with other matters."

Daydreaming, akin to fixation, is effectively destroyed by sound—abrupt sound—slamming a door, dropping a book, popping a balloon. Why not destroy the fixation instead of the aircraft or the lives? Destroy the fixation, before fuel starvation, *before the engine quits*, by sound—by abrupt, disagreeable, repetitious sound. Of course, don't slam doors, or drop books, or pop balloons.

Instead—install a version of the Bell UH-1B (D) "low rpm audio" modified to respond to "low fuel audio." I'm certain Bell could produce the item—and destroy fixation.

For the want of a nail . . .
For the want of a fix . . .

MAJ MICHAEL R. THOMAS
765th Transportation Battalion
APO San Francisco 96291

William H. Smith

Helicopters you may fly in the future as we peer into the . . .

Helicopter Crystal Ball

IF EXPERIMENTAL helicopters coming from the factories today are any indication, the choppers we fly in the next 10 or 15 years will look generally like the ones we fly today. They will still have main rotors on top and in the case of some single rotor craft, a tail rotor hung on behind. But while they'll look much the same on the surface, underneath they will be greatly improved.

In a few years we will probably have V/STOL aircraft in the inventory and we will have to remember that they are different from helicopters. Even though they do about the same thing, the degree of performance is different, which puts them in different categories. For instance, helicopters can hover more efficiently than V/STOLs, while V/STOLs should be able to fly much faster.

At this time it does not appear that all the functions performed by helicopters can be accomplished more economically by V/STOLs. This is not to say that V/STOLs won't be successful. They will be used to fill a particular need while the helicopter will probably still be used in most of its present roles. Due to product improvement, helicopters may even take on some role not now assigned to it.

TYPES OF HELICOPTERS

In the next few years we will be concerned with three general types of helicopters: pure, compound, and composite. Pure helicopters are in general use today. Main rotors or wings rotate in a substantially horizontal plane and throughout the flight supply lift and propulsion.

In compound helicopters there's still a main rotor, and it acts about the same as it does in pure helicopters. But in addition to the rotor it also has a wing which serves to unload the rotor system during forward flight. It may or may not have auxiliary engines for additional thrust.

Composite helicopters are capable of converting to a fixed wing aircraft during flight. Total lift is transferred from the rotating wing to fixed wing and thrust is furnished by some other means.

TYPES OF ROTOR SYSTEMS

Besides pure, compound, and composite helicopters, we may find new types of rotor systems in use. Most helicopter companies have developed a rotor system of their own or purchased one already developed from some other company. These are similar to each other and may be classified as standard.

Many new types have been developed and some bear watching as they may take the place of the standard rotor systems in the near future. Some recently developed ones are the hot cycle rotor, rigid rotor, matched stiffness rotor, and door hinge rotor. The Army is interested in all of them as each has certain advantages. All are supposed to simplify the rotor system, allow greater speeds, and be more efficient.

The door hinge or Model 540 rotor is already being placed on UH-1B helicopters.

Hot Cycle Rotor System

In comparison with standard rotors, the hot cycle rotor, developed by the Aircraft Division, Hughes Tool Company, would seem to be the most revolutionary. This is not true, however, because it has its genesis in Hero's turbine made some 2,000 years ago in Alexandria, which may well be the first type rotor ever built. A generator, consisting of a kettle of water heated by fire underneath, produced gas (steam) which was ducted into a sphere and out through two jets directed to produce rotation.

Hot cycle pressure jet systems eliminate gear boxes, mechanical drive components, and antitorque tail rotors. The system is powered by diverting high energy gases from turbojet engines through the rotor blades to be exhausted out the blade tips.

Fuel consumption is about the same as conventional systems even though its propulsion efficiency is about 35 percent less than shaft driven systems. This is possible because of the lower weight and simplicity of the system.

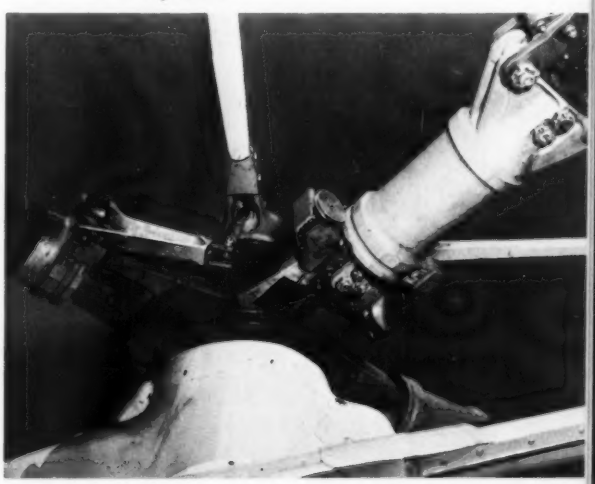
Under a contract with the Army, Hughes built the XV-9A research helicopter to evaluate the hot cycle rotor.

Rigid Rotor System

Another new rotor system is the rigid rotor. For nearly half a century rotary wing designers have hinged blades to the mast to overcome forces resulting from the gyroscopic action of the spinning rotor. The Lockheed California Company has developed a rotor that is not hinged but held firmly to the mast.

To test the concept a joint Army/Navy contract was let to construct two research helicopters called the XH-51A (more fully described later). In the XH-51A the mast or shaft is directly driven by the transmission, which is attached rigidly to the fuselage structure. A control gyro gimbaled on top the rotor mast acts as a stabilizer and has a rotor control device. A spring-loaded linkage provides a means for the pilot to control gyroscopic forces.

The rigid rotor was explored even further under a contract for project definition of an Advanced Aerial Fire Support System (AAFSS). As a result of the findings from this project the Army has let a contract with Lockheed for 10 prototype high speed AAFSS helicopters using the rigid rotor system.



The rigid rotor has a gyro stabilizer control system

Matched Stiffness Rotor

In the meantime, research is being conducted on another rotor system called the matched stiffness rotor. It is similar to the rigid rotor but is even more simplified.

The matched stiffness rotor has a flexure hub and blades which are matched in flapping and in-plane stiffness and eliminate the need for cyclic bearings and permit the use of a much smaller control gyro than in rigid rotors. The system has a box beam section which serves as a spar and is the only load carrying member in the rotor. Since the airfoil glove does not carry a weight it can be made of lightweight material.

Matched stiffness rotors, according to Lockheed California Company, are 20 percent lighter than present rigid rotors and cut drag by 50 percent. The new rotor has been wind tunnel tested at speeds up to 275 mph.

Under an Army contract, Lockheed is now constructing a 35-foot full scale matched stiffness rotor for flight testing.

Door Hinge Rotor System

Bell Helicopter's Model 540 door hinge rotor is already in production and is being installed on UH-1Bs. It is like Bell's standard two-bladed rotor system but provides more speed and maneuverability without compromising component life. It is also designed to reduce maintenance because it has lubrication-free Teflon bearings in the hub.

A design study made by Bell with a newly developed computer shows that their rotor system should have flexures near the center of rotation and high blade tip weights. Vertical oscillatory forces produced by air loads at high speeds would then be dampened within the rotor, rather than transmitted to the fuselage.

As a result of the above finding, Bell designed a new hub with high chordwise stiffness to reduce oscillatory loads. The standard UH-1B main rotor blade was also redesigned to include an increase in blade chord width from 21 to 27 inches, resulting in increased maneuver and high speed capabilities.

PURE HELICOPTERS

One would think that after so many years of development pure helicopters would have reached their zenith of perfection. But this is not so. All sorts of new ideas keep cropping up, indicating that many improvements are still to be made.

A good example is improvement in engine efficiency without a substantial increase in weight or size. Lycoming has, without changing outside dimensions, developed a new engine with 300 more shaft horsepower. And incredible as it may seem, the new engine uses less fuel to get these additional horses.

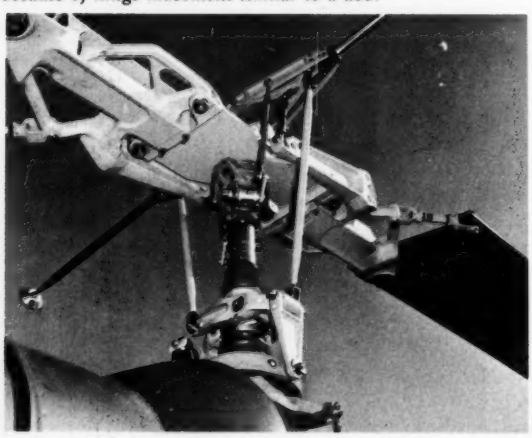
Light Dual Engine Helicopters

One big problem of a single engine helicopter is that the pilot has no power except the aerodynamics of autorotation to help him get down to earth if the engine should fail. The safety feature of an additional engine is why the president of the United States is carried around in dual engine helicopters.

Twin-Turbine Helicopter

Bell Helicopter is testing a light twin engine version of a UH-1D that they call the twin-turbine helicopter. It has two Continental XT-67-T-1 turbine engines instead of one Lycoming T-53-L-11. An automatic device provides equal torque splitting between engines. If one loses power the remaining one takes over.

Model 540 system has been dubbed the "door hinge" rotor because of hinge movement similar to a door



The twin-turbine helicopter is a modified UH-1D with two Continental free turbine engines

Both engines have a combined takeoff rating of 1,400 shaft horsepower, a maximum continuous rating of 1,200, and are capable of 2½ minute rating of 1,540. With one engine gone enough power remains to allow the pilot to maneuver the helicopter safely to the ground.

To make the prototype the Army furnished a UH-1D frame, Continental Motors furnished the powerplant, and Bell Helicopter Company did the work of putting the thing together.

HIGH SPEED PURE HELICOPTERS

Every effort is being made to increase the speed of pure helicopters. Besides new type rotors and more efficient engines, emphasis is also being placed on streamlining.

Lockheed XH-51A

A good example is the XH-51A. This helicopter was built by Lockheed-California under a contract with the Army to conduct high speed flight research with rigid rotors.

Considerable attention was given in the design to reducing aerodynamic drag. Some significant features are clean lines, flush-riveted fuselage, and retractable landing gear. There are no movable surfaces on the helicopter. Horizontal and vertical stabilizers are conventional except that the vertical tail is cambered to unload the tail rotor during high speed flight.

XH-51As are powered by Pratt & Whitney PY-6 free-turbine engines with 500 shaft horsepower. To get every ounce of power from the engine, even air intake and exhaust are made to furnish thrust. Air enters through two flush type NASA scoops which add to streamlining. It exhausts through side exits which are deflected slightly aft to give a small thrust in forward flight.

Streamlined UH-1B

Bell Helicopter Company has also been experimenting with decreased fuselage drag. In the latter part of 1962 they took a UH-1B and tilted the pylon, allowing the rotor to be tilted forward while the fuselage remained in its minimum drag position. They also streamlined the landing gear, cambered the vertical tail surface to unload the tail rotor in high speed flight, and added fuselage fairing to eliminate turbulent flow.

The result was a UH-1B that could fly in level flight speed at 152 knots instead of 120 knots normal maximum speed of the basic machine. Later they converted this helicopter to a compound helicopter to achieve even greater speeds.

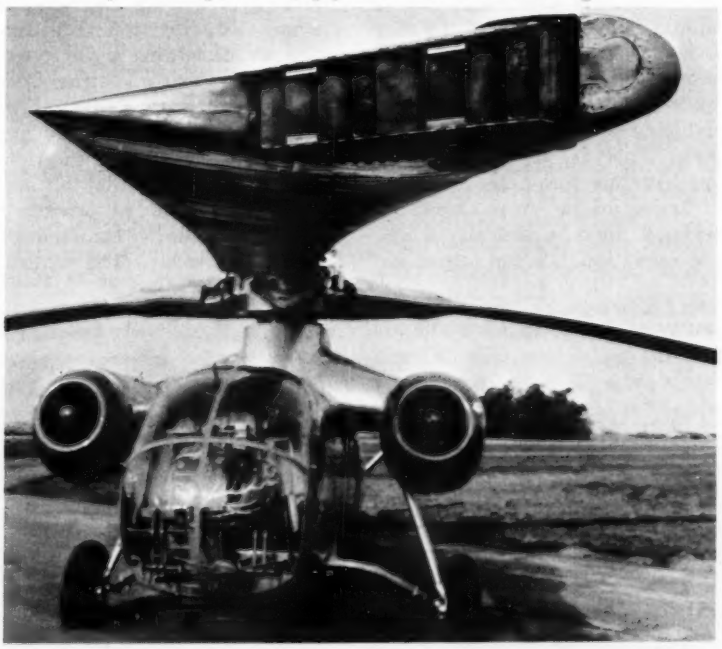
PURE HOT CYCLE HELICOPTERS

Built by the Aircraft Division of Hughes Tool Company under an Army contract, the XV-9A is the first hot cycle helicopter ever built. It resembles other helicopters in outward appearance except for two General Electric T-64 gas generator pods mounted on each side of the fuselage, louvered openings at the tip of its three rotor blades, and the lack of a tail rotor (there's no shaft torque to counteract). Near the tail are gas valves to control yaw.

Rotor diameter is 55 feet, overall height of the helicopter is 12 feet, and length is 45 feet. It weighs 8,600 pounds with a design gross of 15,300 pounds. Maximum speed is 170 mph at 10,000 pounds gross weight.

Hughes also has an Army contract to conduct a preliminary design study of a 12 to 20 ton payload hot cycle rotor system helicopter. It will be similar in design to the XV-9A. It will probably have four engine pods mounted like those on the XV-9A and the rotor will probably have three blades.

XV-9A "hot cycle" helicopter can lift payloads more than its own weight



Kaman UH-2 has a YH-85 jet engine and "Queen Air" outboard wing panel

COMPOUND HELICOPTERS

Most manufacturers convert their pure helicopters to compound helicopters by adding a jet pod and/or stub wings. Jet pod is a relatively simple, inexpensive way to get high speed without substantially increasing the helicopter's size and weight, or changing basic engine and drive systems. The wings partially unload the rotor during high speed flight, thus allowing the helicopter to fly much faster before there is danger of rotor high speed stall.

Sometimes spoilers are added to the wings. If the rotor engine should fail in high speed flight, it is necessary to enter autorotation promptly to prevent excessive rotor speed decay. Some means of reducing wing lift is usually necessary. This is where the wing spoilers come into play.

Transitioning from hover to forward flight is basically a simple operation. To get initial forward speed while hovering, the conventional method of lowering the nose can be used. But most often the method used is to slowly increase power to the forward thrust engine with no change in aircraft attitude.

To transition from forward speed to hover, just the opposite method is used.

UH-1B Compound Helicopter

Bell Helicopter Company has taken its high speed version of the UH-1B and added stub wings and two Continental J69 auxiliary jets. As a compound this aircraft has reached speeds of 250 mph.

While flying at this high speed, the helicopter used only 780 horsepower of the available 1,100 horsepower of the main engine plus 1,210 pounds of thrust from the J69 auxiliary engines.

XH-51A Compound Helicopter

Under an Army contract, one of the XH-51A pure helicopters has been modified by the Lockheed-California Company to a compound by the wing and jet pod method. Modification consisted primarily of adding a 70 square foot wing, a Pratt & Whitney J-60, 2,500 pound thrust jet engine on the left side and counterbalancing it with a battery pod on the right wing tip. The horizontal tail area has been changed to provide a near-neutral stability contribution from the fuselage. The already cambered vertical fin, which partially unloads the tail rotor, has been extended 6 inches to help offset the asymmetric thrust of the J-60 engine.

Other modifications are minor ones. The J-60 auxiliary jet engine throttle is placed adjacent to the collective control stick. Installed on the collective control stick is the starter switch, a main rotor engine governor select control, the directional trim tab switch, and a spoiler actuation switch.

The four bladed rigid rotor that had been installed when the aircraft was a pure helicopter was left untouched.

The helicopter is 32 feet long, 9 feet high, and has a rotor blade diameter of 35 feet. Its stub wings have a 17 foot span.

At 12,000 feet the XH-51A compound has flown 263 mph and at 15,000 feet it has flown 272 mph.

Piasecki Compound Helicopter

Another interesting compound helicopter is the Piasecki Aircraft Corporation's 16H-1A. It was developed from the original "Pathfinder," the first completely shaft-driven compound helicopter to be flown in the free world. The Army is using it to get information and data on the characteristics of shaft-driven compound helicopters at flight speeds in excess of 225 mph.

It has the usual stub wings

This UH-1B has been modified with two auxiliary jet engines and stub wings

XH-51A research helicopter was built to provide design data for future high performance rotary wing aircraft

The 16H-1A is the only 100 percent shaft-driven compound in the U. S.

A thrusting pusher propeller will give the AAFSS continuous forward propulsion

found on compounds but is different from other helicopters in that it has a ring tail propeller for propulsion. A propeller-vane arrangement in the ring tail furnishes antitorque and directional control and eliminates the usual tail rotor. It is powered by a 1,250 shaft horsepower T-58 gas engine.

A feature of the 16H-1A is that it can be operated as a short takeoff and landing aircraft (STOL) using a rolling takeoff like a conventional aircraft. When used in this manner it can double its payload or double its fuel load for extension of range. Part of the Army's contract with Piasecki calls for an investigation of this feature.

The Lockheed-California Company also has an Army contract to study a shaft-driven rotor system.

Kaman UH-2 Compound Helicopter

Kaman Aircraft Corporation also has had an Army contract to investigate one of its helicopters converted into a compound. At first, Kaman simply mounted a YJ-85 jet engine on the side. It soon became evident, though, that without wings to help unload the rotor, additional speed that could be obtained with the thrust engine was limited.

So it was decided to add outboard wing panels from a Beech "Queen Air." These were simply bolted onto the fuselage. The aft UH-2 fuel tank had to be removed so the Beech internal wing tanks took its place. Wing attaching hardware was constructed so the wing incidence angle with respect to an aircraft waterline could be changed on the ground. To provide a means of changing wing lift at a given flight speed, the standard UH-2 horizontal stabilizer was modified to allow the pilot to change the stabilizer incidence angle and, consequently, the aircraft attitude while in flight.

With wings added, the Kaman UH-2 flew at 218 mph. This speed was obtained using the full power of the thrust engines. Tests show that the rotor airspeed limit was even higher. Consequently Kaman wants to add another thrust engine to the craft to test the full high speed envelope of the UH-2.

Lockheed AAFSS Compound Helicopter

Army's new Lockheed Advanced Aerial Fire Support System (AAFSS) is to be a compound helicopter. Both rotor and thrust mechanism will be powered by the same engine. It will have a rigid rotor and be able to fly at a speed of more than 200 mph.

The helicopter will have a combination pusher propeller and a tail rotor to give it forward propulsion and directional control in high speed flight. While in high speed flight, the rotor will be completely unloaded by reducing the angle of attack to zero degrees.

A complete rotor system will be built and tested soon. The first of the 10 prototype AAFSS helicopters will be for ground testing and should be ready by this fall. First flight of the new helicopter will be in 1967.

COMPOSITE HELICOPTERS

At this time, the major effort in the research helicopter project is an advanced high speed rotary wing aircraft (the high speed composite helicopter). This aircraft will combine the good hover capabilities of the helicopter and the efficient high speed characteristics of the fixed wing aircraft. The aircraft will be designed to operate in the lower portion of the speed spectrum much the same as the compound helicopter. As speed increases, the fixed wing gradually assumes the aerodynamic load from the rotor. When the rotor is unloaded, it will be either stopped, stowed, or tilted, and the aircraft will operate in the cruise

mode as a fixed wing aircraft. To land, the procedures are reversed.

In November 1965, three contracts were awarded (Bell, Hughes, Lockheed) for the preliminary design study of different approaches to the high speed composite helicopter. It is planned that one of the designs will be selected and fabrication of full-scale test aircraft will be undertaken. As a basis for the design competition, the design of this aircraft is based on a 3,000 pound payload, 3,000 pound fuel capacity, and an internal compartment size of 5.5 feet wide, 6 feet high, and 14.5 feet long.

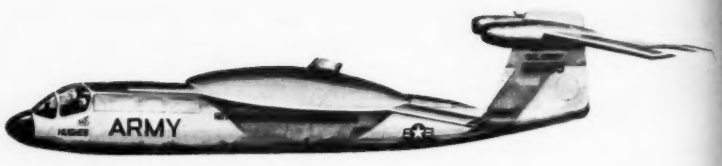
Lockheed Composite Helicopter

Lockheed-California Company has an Army contract for a preliminary design study of a helicopter using the fold and store method. The helicopter would be able to fly at 400 mph.

Hughes Composite Helicopter

Hughes' contract is for a preliminary design of a hot cycle helicopter that converts into a 400 mph airplane.

It will have a single rotor with a large triangular hub. After lift-off and acceleration to about 150 mph, the rotor will be stopped in a position for the hub to serve as a wing, allowing the aircraft to operate as a high speed, delta winged airplane. For landing, the aircraft slows down, the rotor starts, and the aircraft lands as a helicopter.



Sketch shows Hughes hot cycle helicopter using the "rotorwing" concept

In high speed flight, with the rotor stopped, high energy gas from the engines will be jetted straight to the rear of the aircraft to provide forward thrust.

Bell Helicopter XV-3 and D266

One helicopter (or is it?) that could change the future appearance of Army aircraft is the old XV-3. This is a strange craft that looks almost like a fixed wing, except it has rotor blades on the very tips of the wings. To hover they face skyward and convert by tilting forward.

The XV-3 was built for the Army in 1955. Although it had a lot of good features it also had one major problem: rotor/pylon instability in airplane flight. Using new computer techniques, which weren't available at the time the XV-3 was designed, the Bell Helicopter Company has tried to solve the problem.

Early this spring it was sent to National Aeronautics and Space Administration's Ames Research Center at Moffett Field, Calif., for tests in the 40 to 80 foot tunnel.

The tests have now been completed and according to Bell Helicopter Company they confirm analytical and model testing data used in the design of their Model D266 composite research aircraft.

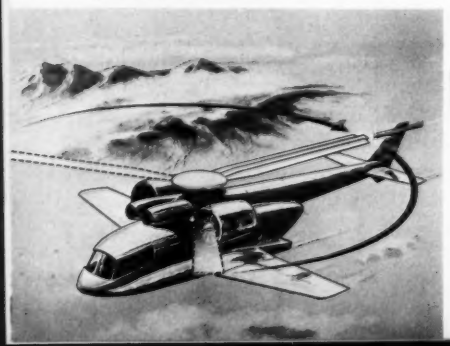
The D266, according to Bell, should cruise at well over 300 knots and be highly efficient in both the vertical and high-speed flight regimes. Data on the D266 has been submitted to the U. S. Army Aviation Materiel Laboratories at Fort Eustis, Va., for evaluation.

CONCLUSION

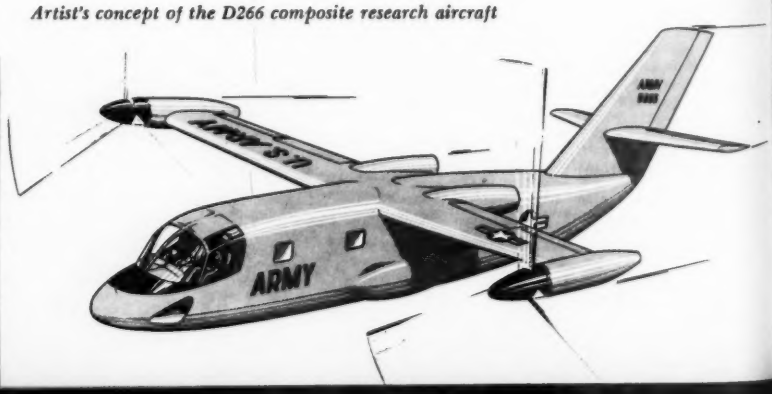
With all of these new developments it's a safe bet that helicopters will be around for a long time to come. They will be much improved, of course, and will be able to fly at a high rate of speed and lift greater loads.

Our big problem will be to keep the different types separated. The pure, compound or composite helicopter will each have a certain job to do and have the type of rotor system that will be best to do the job.

Lockheed rigid rotor helicopter with fold-back rotor blades



Artist's concept of the D266 composite research aircraft



Misery Knows My Company

Lieutenant James L. George

SATURDAY, 24 July 1965, began as any other day and was proceeding uneventfully until I was called to the phone. After answering, rather nonchalantly, I was informed by the colonel that the Army Aviator's dream had come true—a 10 day TDY trip to Toronto, Canada.

After preliminary preparations were completed (collection of advance TDY pay), we broke ground at approximately 0930 hours on Monday in our trusty Beaver, complete with pilot, copilot, crewchief, and all the baggage we could muster.

We touched down in Canada at noon on 28 July and enjoyed the Canadian hospitality immensely until 4 August. On this day my troubles began.

It had been decided that one of the crew should remain in Canada with the project we were working on and I was to fly the airplane home—providing the weatherman could muster up enough VFR type weather. Normally I would look forward to a trip of this nature. But a flight from Canada to Fort Rucker in a supercharged U-6A, with a wind from the south and a crewchief who is one of the best in his field but knows absolutely nothing about flying, promised to be a long, drawn-out affair.

After clearing customs at both Toronto and Buffalo, I planned my refuel stop and layover at Zanesville, Ohio. This was the approximate halfway point along our flight route (a very good friend of the family just happens to live there).

The trip to Zanesville was uneventful but extremely tiresome. We arrived at 1630 and by 1800 were feasting on free steaks and discussing the pros and cons of the world situation over a few sociable gulps.

I awoke rather refreshed the following morning and filed VFR to Cairns AAF, Fort Rucker. The weather briefing at ZZV was complete, if not accurate, and we said our goodbyes at approximately 1230.

We filed for 8,500 (the best winds and visibility) but could only get to 4,500 due to scattered (?) conditions and decreased visibility at higher altitudes. The visibility at 4,500 was variable from 3 to 5 miles, and the scattered cumuli were not as scattered as they were supposed to be.

It took approximately 1 hour (63 nm from Zanesville) for the previous day's weariness to return. Two minutes later I had a change of destination to Charleston, W. Va., where we relaxed and considered the feasibility of continuing our flight.

We decided to refile and again were advised to elect 8,500 feet. The MEA along this particular leg was 6,000 and our altitude varied from 6,500 to 12,500. The flight path resembled that of a drunken water moccasin. Fatigue, with eyestrain and headaches, came quickly.

Weather conditions failed to improve with sunset. After the blinking red light confirmed my suspicions that the fuel gauges were inoperative, I decided to again change destinations. We refueled the aircraft and ourselves at Fulton County, Ga.

With the exception of severe headaches and extreme weariness, the flight from Fulton County to Fort Rucker was uneventful. The runway lights at Cairns AAF are, without a doubt, the most beautiful lights in the world. We landed without incident (on all four bounces), and for the first time in 9 hours you could distinguish a small trace of a smile on the crewchief's face.

As noted, this flight was relatively free of incidents or accidents; however, I made many small mistakes during that 9 hours that could have proved vital under other circumstances. I also learned a good many lessons to pass on to aviators who are interested in benefiting from the aches and pains of others. They are listed in their order of occurrence during my flight.

- Whenever possible ensure that you have a person onboard who is capable of temporarily relieving you at the controls.
- Expect and be prepared for eyestrain and severe headaches when flying in conditions of limited visibility.
- Space your flight to ensure that proper rest and foods are available.

The most important lesson learned is the one that prompted me to write this article: Never attempt to extend your physical capabilities for the sake of arriving on time. It took three full days for the headaches and miscellaneous pains to subside. And the first statement I heard upon arriving was, "Well, you're early. We didn't expect you until tomorrow."

...ance and the ...Mountains

Capt ...

OUR UNIT received orders to conduct semiannual mountain training in the beautiful Bavarian mountains.

Having been alerted to this new and different adventure, the maintenance section began detailed preparations for its role in the exercise. One of the first steps was the selection of particular aircraft to be used, preferably a "high time" or aircraft just out of periodic inspection. Because of the unusual phenomenon of mountain flying, the unit's most experienced crewchiefs were selected. They can be a great aid to the aviator on the tight mountain pads and in sling-load operations. When possible, younger crew personnel should be taken along to learn the ropes so to speak. This type exercise is excellent training for crew and maintenance personnel as well as aviators.

Now that we have our aircraft and personnel selected there's still much work ahead of us. Each aircraft is given a safety of flight inspection by the unit tech inspector. Aircraft should be cleaned and weighed, and a completely new accurate weight and balance computed. A weight and balance form is used to determine the allowable load for each flight during the training. High elevations and density altitude make loading extremely critical in mountain flying.

Each aircraft is given a thorough test flight, placing special emphasis on unusual vibrations which should be traced and corrected by blade track, balancing and whatever is necessary to ensure that a good smooth aircraft is sent to the mountains. Brakes, if applicable, must be checked carefully to determine if they will hold properly on a sloping moun-

Capt Wiard is Aircraft Maintenance Officer, Co A, 503rd Avn Bn, 3rd Armd Div, U. S. Forces, Germany.

tain helipad. It is a good idea to test it with a slightly heavier load than normally carried during training. Be absolutely certain that all cargo hook releases will respond immediately if needed in an emergency.

While the aircraft are being prepared, the maintenance officer must initiate close liaison with several other people. He must visit the weather officer to obtain information on the type weather to be expected for the particular time of year. From this it can be determined if it will be necessary to take blade covers and other frost protective equipment. If extremely cold weather is expected, heaters must be included to preheat and remove snow and ice. Auxiliary power units to aid starting *must* be included regardless of weather.

A conference with the operations officer as to expected flying hours is necessary for the determination of POL requirements. Due to higher power settings in the mountains, fuel and oil consumption will be increased slightly. More fuel must be taken than on normal field problems. If a sizeable number of aircraft are to go, or an extreme amount of flying is expected, it may be necessary to borrow a 5,000 gallon tanker from the Supply and Transportation Battalion. This will supplement the unit's 1,200 gallon M-49Cs.

Our unit has an extremely good working relationship with its direct support (3rd echelon) maintenance. We have a small CH-34 contact team permanently assigned with us to perform necessary direct support work at our location. It has always been found advantageous to take at least part of the team with us on field problems, mountain training being no exception. During our most recent mountain exercise the team completed a transmission change at our site as well as some other tasks above organization level. By having this team, with a small supply of commonly needed parts, we were able to save much valuable training time.

While on the subject of repairs and repair parts, it is advisable to have an aircraft on standby at the home station to make necessary maintenance or parts runs. The ship could even be on a scheduled basis if desired. It is also a good practice to have one or two spare aircraft. Each spare should be prepared exactly as the original ship.

Now let us look at some of the procedures to be used during the actual training process. Before each flight a weather check is made. This is used in computing the load to be carried on the flight. A thorough preflight, to include another ground check of the sling hook is a must. Before any approaches to the pads are made a series of power checks are conducted to ensure that adequate power will be available when needed.

The "buddy" system should always be used when mountain training—one aircraft shoots an approach while a chase ship circles a short distance away. For safety reasons this is very necessary. It is also useful from the maintenance standpoint. The high power settings cause extreme wear on internal parts. Sometimes this wear can be detected before an actual engine failure occurs by indicators such as excessive exhaust smoke. The smoking may very well go unnoticed by the crew but could be sighted by the chase ship. A warning of this type could get the aircraft to the ground to be inspected or repaired before a more serious problem develops.

After a day's mountain flying it is imperative that a very detailed daily inspection be performed. The aircraft has encountered abnormal stress and power settings during its flight. Stress points must be checked closely. Oil consumption should be monitored with

Sling loads are a very important phase of mountain training.

Each aircraft is given a safety of flight inspection

great accuracy. Magnetic sump plugs must be checked more often than usual. Rotor blades must be carefully inspected.

The experienced crewchief is invaluable in the performance of these duties. He also is familiar with the idiosyncrasies of his aircraft and is able to tell if a certain noise or smell is unusual and needs attention.

When the training is completed and all aircraft have returned home there is still much work remaining. The tech inspector should once again make a complete inspection of the aircraft that participated in the vigorous flying activities. He should concentrate on the items discussed above, only in more detail, plus any other areas he feels should receive added attention. All forms and records should be audited carefully to ensure that all time has been entered properly, fuel and oil recorded, and proper entries made for any items that were changed on the aircraft.

It will normally be a few days after this type of exercise before all the aircraft are back in normal operating condition. Aside from all of this hard work it is a rewarding experience for all personnel concerned. It gives the individual aviator invaluable flying experience as well as introducing maintenance personnel to a new and different challenge in their all important duty to Army Aviation.

There are no hard and fast rules for maintenance during an exercise of this type. Each unit will have its individual requirements. I have only pointed out a few of the more important items in hopes that they will be of some aid to other maintenance officers. They have helped this airmobile company to qualify many aviators for mountain flying and maintain its perfect safety record.

Th

ZERO DEFECTS or a form of ZD has been a way of life for Army Aviation mechanics since aviation became a part of the Army. It had to be so or the first aircraft repaired by the first Army Aviation mechanic would have crashed before it got to the end of the runway.

ZD is said to be a state of mind. Most people believe that we all make mistakes once in a while and that on the job a certain amount of error is normal. ZD on the other hand rejects this idea. ZD advocates say that in many of our everyday affairs we don't allow ourselves to make mistakes. We don't, for example, put salt in our coffee or water in the gasoline tank of our car. Then, why should we go around assuming that we will make a certain number of mistakes in our work?

Many people assume that all of us cannot be perfect all of the time. They say that many factors influence a worker and that the best we can do is try to be as perfect as possible.

In Army Aviation, however, we cannot accept the fact that one out of every 10 or 20 or a 100 aircraft will crash because some mechanic made a normal mistake. We must be perfect in our repair work at all times. There are many reasons why we can.

One reason is the nature of the beast we are working with. If an Army mechanic does something to cause the engine of a wheeled vehicle to quit somewhere on an Army post, the people on board may have a long walk but they are not in physical danger. But if an air-

Mechanic's Challenge

craft mechanic does the same thing to the engine of a OH-13, the unrelenting law of gravity takes instant control and the results may be fatal to all on board. Thus the aviation mechanic is inspired to perfection by the awesome results of a mistake in his work.

Another reason we can reach the goals of the ZD program is the importance of the aviation mechanic in the scheme of things. In a large factory many of the workers feel, and in truth are, just a cog in the production machinery. They feel that the work they do is so small and insignificant that if they make a mistake it won't matter or that some inspector up the line will catch it. Sometimes these workers are so frustrated that they actually make mistakes to draw attention to themselves. The aircraft mechanic realizes that his situation is different, that he is part of a team including the aviator, crew, and command.

Operation of our aircraft presents the greatest safety challenge in the history of Army transportation and the aviation mechanic is inspired to meet this challenge. Aircraft operate in a three dimensional environment and must continuously fight this environment. The equipment is bedeviled by limitations of weight and space which compound the economic and operational problems, and it has more scientific principles and technical variables than any other system of transportation.

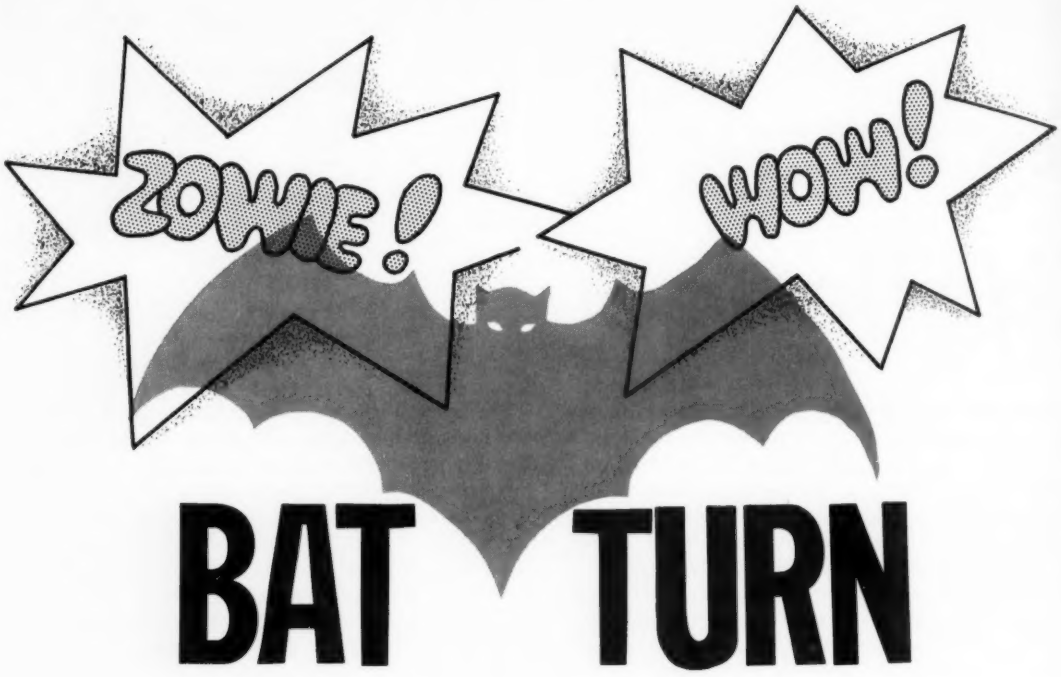
At one time a good draftsman with some handbooks could design an airplane. Some of these men had less training than that of an average mechanic. Today engineers and researchers make life difficult for the maintenance man by creating ever more sophisticated problems for him to solve. The skill and intelligence level required of the Army Aviation mechanic is therefore becoming higher and higher.

The mechanic is faced with many other problems, and he is managing to solve them. One of these is that higher speed and more complicated aircraft are being introduced into the Army inventory. Mistakes and failures are likely to be more catastrophic than they are in a slower aircraft. The mechanic is countering this problem by making his work more precise and refined.

But skill and intelligence has not been enough. The aviation mechanic also has integrity. He doesn't undertake a job for which he is not qualified and competent, and he has the guts to admit this to his superiors. He takes nothing for granted. He doesn't assume what a manual says, but reads it before he starts to work. Once he starts to work he checks and doublechecks, invites inspection, and is proud of his ability to hold up under inspection. He is proud of his ability to communicate to his successor or fellow mechanics. He completely informs his successor of the status of the work which is left to him to finish.

Since the mechanic is so important on the aviation team and is under so much pressure, he is subject to emotional, spiritual and intellectual forces that influence his work. Like the aviator, his personal habits may make the difference between life and death of those on board the aircraft he has just repaired. For this reason the mechanic constantly monitors his personal life and tries to improve emotions and attitudes which affect his work.

These are just a few of the reasons why it is possible for the Army Aviation mechanic to live up to the ZD program. The mechanic can meet the goals of the ZD program because he is motivated by a deep inner conviction or compulsion that permits him to make no individual indifference or surrender to expediency or the taking of anything for granted in carrying out his responsibilities.



BAT TURN

Lieutenant Ronald M. Altman

THEY WERE traveling at super speed in pursuit of the Riddler. The Dynamic Duo cornered a bend in the road, faster and faster. "Look out, it's a smokescreen." I began to sweat. "Hang on Robin, we'll have to make a BAT-TURN."

Luckily Robin spotted a hole in the enveloping fumes. "Jumping thunderstorms, Batman." The Bat Chute deployed; screeching brakes and burning rubber accompanied the 180° turn. My palms were wet.

"Power on. We made it, Robin."

I was still feeling uneasy when the commercial came on and I switched off the TV. I sat back in my chair and started to remember . . . "Bat-Turn . . . Bat-Turn." It all came back now, I had made a "Bat-Turn"—believe it or not, in a U-6A.

I hadn't thought about it in over 2 years, but I remember it clearly now. Yes . . . yes . . . I know why I feel this way. It all started when my flight wings were as brand new and sparkling as my 2nd lieutenant's bars. I had been in Korea for only 2 weeks and had just completed my second solo mission in the Beaver. When I returned, Captain Batons, the operations officer was on the hot line. "We have some flashing mirrors, veri-pistols and shark repellant that must get to Tageu. Can you take the flight?" I knew it was the right signal. At last I was needed. A snap 3-hour flight. What could be swifter? I eagerly accepted.

The sun was bright, the sky clear, and there was a nondirectional beacon at the destination just in case . . . "To the Beaver, Robin." As the crewchief, SP/4 Jay Robin, climbed into the copilot's seat, I cranked up. We climbed to 4,500 feet, and everything was fine for the first 45 minutes. This was going to be easy. We had some rugged terrain to cross, but great jumping mountain range it was no sweat.

Wonju was my first checkpoint. Everything looked good so far and we were right on schedule. Just past Wonju I noticed what ap-

Lt Altman is Aviation Officer, Army Avn Div, U. S. Army Training Center, Ft Dix, N. J.

peared to be light snow or rain obscurring the tops of the mountain range just ahead. No problem, I would just add climb power and continue VFR. I didn't know enough then to turn back.

My idea was to get above the clouds rising from the tops of the mountains. I reached VFR on top at 6,500 feet. About 15 minutes later I was flyng over a broken layer at 8,500 feet and still climbing. The Wx report had been good, so I decided this was just a local condition over the mountains. I was beginning to have a little trouble making out my checkpoints when the cloud layer, still sloping upwards, became overcast.

We carried main tanks full only. That was SOP and by now we had reached the point of no return. I applied full power to the Beaver and when we reached ten-five the old gal refused to go higher. This put Robin and myself in a somewhat awkward position. The lower half of the plane was in the clouds, and was wading through the overcast while the wings were basking in the sun.

I figured NOW was the time to tune in the NDB. That's when I knew we were in trouble! Whiz, spin, zap, zing—what a puzzling predicament. I could see the needle going in circles, alternating clockwise, then counterclockwise; it was no use. I kept my heading and began to sweat. I was thinking that Robin and I could not let Batson down, no matter what the odds were.

"Look a break in the clouds."

"Holy heavens, Robin; good work!" I could barely see the ground; it was starting to close already. I could solve this riddle by diving down the hole. "Hang onto the utility plane, Robin; we're going down."

"Wow this is socko!" cried Robin.

I made seven Bat-Turns to keep in the clear. Believe me they were Bat-Turns; they had to be! If we got caught in the soup we might flatten one of those mountaintops simmering in the clouds.

When I finally regained control of the plane, I reached for my map. I couldn't match up anything. The fuel supply was getting lower and lower, and all this climbing and diving hadn't helped any. The terrain below looked like the far side of the moon. I didn't think I would appreciate a survival operation this soon, so we pushed on, Robin and I. The map still wasn't making too much sense when I spotted a dirt strip, located in a saddle. Either it wasn't on the map or I wasn't, so I took a closer look.

"We had better find out where we are, Robin." I tried not to worry the boy.

It only took two more Bat-Turns and we were on final. When I regained control, I lined up for a westerly approach. The strip didn't allow for too many errors; it was shorter than I had anticipated. The more I thought about it, the more I wished I had taken Batmobile training instead. Great bouncing beavers, I must have used up every inch of runway before we came to a screeching halt.

Quickly I got out to look around. I left the engine running while Crewchief Robin was standing on the brakes. A crowd gathered quickly. "Where am I?" I yelled to the crowd. Cooling Kimchi, I should have known they couldn't speak English. I decided to try a different approach as not to be conspicious. Jumping up and down I yelled, "Tageu? Tageu!" I tried to be calm, giving the international sign for "I'm sorry about that."

Finally, a Korean farmer approached me. He was smiling as he came closer to return my international signal. He looked at my aircraft, shook his head, and pointed southwest. I repeated, "Tageu? Tageu?" He nodded his head. Tumbling tumble turns, I showed him the map; he studied it and finally he scratched his head. I knew then he didn't know what to make of it either.

Calmly I started screaming, "Tageu!" He continued to point in the same direction as earlier. That was a good sign; I was convinced we had made contact. I stood behind him and sighted over his shoulder and said "Tageu?" again. He continued to point, so I lined up on a couple of mountains down range, thanked him, and climbed back into the plane.

Zooooooom, we were off. As soon as the Beaver broke ground we hit an updraft. The climb indicator pegged when it hit its upper limit. I held the yoke with both hands as we wheeled skyward.

"Very courteous these Koreans. We must remember to repay them by always remembering flight safety, Robin." I pointed the Beaver in the last direction I had received, and sure enough 25 minutes later Tageu jumped into sight.

Oh, by the way about 3 minutes out of Tageu the needle perked up and held steady. Just another completed mission, I was thinking—or was it? I'm strictly a VOR man now, and I leave the Bat-Turn for TV.

INDIVIDUALISM AND PROFESSIONAL PRIDE

Captain William E. Keller

TOO OFTEN when one mentions professionalism in Army Aviation the listener jumps to an unwarranted conclusion. Professionalism is not being able to fly a specific aircraft better than anyone else; nor is it being the best instrument pilot in the world. You could be either or both of these and still be a highly unprofessional slob.

Professionalism stems first from basic soldierly traits: wearing of the uniform, enlisted/officer relations, individual pride of ability and accomplishment, plus the greater pride of your contribution toward the teamwork and proficiency of your unit.

It is a burden to prepare a uniform, to shine brass and shoes each night, but it is a soldier's burden. This is part of the price you pay for belonging. Uniform regulations were not written for harassment or for pouring everyone from the same mold. They were written so that as soldiers we may present a badge to the world that we are members of the greatest fighting force the world has ever known.

What type of impression do you, as an aviator, wish to leave with the rest of the Army and the world? Do you belong to a slovenly crew known as Army Aviators? Some of us do! Have you worn red argyle socks with your flight suit or your flight jacket with Army greens or fatigues? Have you failed to shine your shoes or your brass? Have you gone to the PX, the service station, or downtown in your flight suit?

If your answer is "Oh, that's all nit-picking stuff," then it's time to re-evaluate. These are the small outward appearances by which officers and NCOs set the example for their subordinates. Too frequently our attitude is don't do as I do, do as I say. This is a highly unprofessional attitude, and no leader either in the Army or in industry can afford to adhere to it.

Military courtesy appears to be the next logical step along our path to professionalism. At times, the most noticeable thing about military courtesy is the deplorable lack of it. Many people think of it as another means of military harassment and avoid it as often as possible. The enlisted man turns his head to keep from saluting an officer. The officer fails to rise when his seniors enter the office. Commanders fail to return a salute or a greeting. Yet these same people in a civilian community stand in the presence of their elders, answer sir or ma'am when spoken to, and also stand to say good morning when the boss comes through the office.

The only basic difference between civilian courtesy and military courtesy is the *hand* salute—and

Capt Keller was an academic instructor, Dept of F/W Tng, USAAVNS, Ft Rucker, Ala., when he wrote this article. He is now serving in Vietnam.

after all isn't the *handshake* a form of salute? Common courtesy learned at home can be applied in any situation. It costs nothing, can be applied in all situations, makes the day's work more pleasant, and enhances the reputation of the user. If this be the case, then the only reason for not using military courtesy is either ill breeding or carelessness. There is no room for either in Army Aviation.

Let us progress into the realm of professional courtesy within aviation. We have some of the most highly trained personnel in the Army, men who are extremely well qualified in their occupational specialties. On the whole these men are volunteers who are proud of their work and of being associated with aviation. Aviators must depend upon these men and their skills each time they fly an aircraft. Yet, is it fair to burden these people with an overreliance upon their abilities?

When you are assigned an aircraft in the morning and the crewchief says it is ready, do you preflight the aircraft? If not, why not? Are you afraid of casting aspersions upon his ability? No! The preflight is the aviator's responsibility, not the crewchief's. In the field one man may be crewing several aircraft and is responsible for many items which are not readily visible to the aviator. Should he also be saddled with the additional responsibility of the preflight? No! Should he feel that the aviator is doubting him when he does the preflight? No! He should take it as a sign of professionalism on the part of the aviator.

In most cases the crewchief and other support personnel are happy to have the aviator take an interest in their work. Generally they are glad to explain what they have done and why it was necessary. In fact, this is one way the aviator can improve his own technical knowledge while also improving unit morale and teamwork. These people need to know that they are part of a team and that their work is appreciated. What better way can this be done than to have the people whom they support show an interest in their work?

Let us progress now to the individual within Army Aviation. Is aviation the last bastion of the individualist? In many cases it is the last bastion, and wrongfully so. Modern aviation is the product of teamwork and coordination between many people and facilities. The aviator may be in complete control of the aircraft once it leaves the ground, but this is not a license to become a "hot pilot" and race around over the treetops buzzing houses or scaring the farmer's chickens.

It is not a license to show off like a child with a new toy. It is, however, the license of a mature, trained, and responsible individual to exercise the greatest judgment and control necessary to the accomplishment of his mission. Here is the opportunity for the individual pilot to show his proficiency and professionalism by integrating himself and his aircraft into a smoothly working part of the air traffic control system. Here is true pride in individual accomplishment.

What of the individual who states, "I could bust 40 percent of Army Aviators on an instrument checkride and do it legitimately"? Is this a reflection on the training of the 40 percent, a statement of ability on the part of the speaker, or perhaps a little of both? Either way it is a reflection on both the speaker and Army Aviation. If this is true, however, what has this pompous, self-satisfied individual done to alleviate this situation?

Has he contributed any of his time, ability or knowledge to help these people increase their proficiency? Has he taken any pains to assist or explain to junior members of his unit their functions within the unit? Has he taken a mature attitude toward his job and attempted to increase the efficiency of these personnel, or has he looked down his nose at these minions who do not come up to his standards? In too many cases he looks down his nose, mentally pats himself on the back and says, "I am the greatest." His ego drinks at the well of self-gratification and fails to see the larger goal of increased efficiency and teamwork to which he could contribute.

Individualism and professional pride certainly have their places in our system. Every aviator must have pride in his ability, but not at the expense of all other aviators. The philosophy of the great "I am" may be quite good for some people, but it is certainly a juvenile approach to aviation.

The truly proficient, mature aviator does not need to constantly prove his greatness. Your friends don't need to be told, and your enemies won't believe it. Professionalism is not the attitude of the great "I am" but the greater ability of being able to impart to others what you are. It is not constantly proving that you are the hottest pilot in the outfit, but constantly trying to help the less proficient aviator reach your level of proficiency. Demonstrate true professionalism in the number of people, both aviators and ground support, you can assist along the road to a greater contribution to their unit and to aviation.

In short, professionalism in aviation is no different from professionalism in any other branch. It requires the senior, whether officer or NCO, to set the example, in dress, bearing, and action. It requires a great deal of coordination, training and teamwork. Basically the professional aviator is a professional soldier.

This article is an updated version of an Army Materiel Command interim report on the . . .

Development of AAAIS

Willis A. Dworzak

THE ADVANCED Army Aircraft Instrumentation System (AAAIS) is aimed at "cleaning up" the cockpit. Currently the cockpit of the average Army aircraft presents a confusing array. There are round, square, and banana-shaped gauges; vertical, horizontal, and circular reading gauges; T handles; switches and handles that are either pushed, pulled, or turned. Every time the engineers have been asked to solve a particular problem, a gauge or light has been added. Now there are red lights, green lights, amber lights, and lights to tell which lights are working.

Additionally, in a special-mission aircraft, such as an observation plane, for example, cameras and other instruments serve the particular tactical function for which the aircraft is outfitted. At some time in the flight, the aviator needs to be relatively free from monitoring the instruments necessary to fly the plane so that he may turn his undivided attention to the photographic mission. At that time he must manipulate controls and direct the camera toward the target and others that begin the photographic process.

Certain aircraft instruments, because of the vital functions they perform, must be watched attentively from time to time. Others are viewed only briefly in the pilot's normal scan pattern. As a whole, instruments play their most critical roles when the airplane must be flown in inclement weather, at night, especially at low altitudes, and during landing approaches. At such critical times, the pilot often is forced to monitor attentively and simultaneously more than one instrument.

With conventional instrumentation the pilot must scan numerous separate instruments, build a mental picture of his current status, correlate this information with standard operational procedures and the mission profile, and take appropriate action. This process must be continuously repeated to update the required information and to make corrections in aircraft attitude, spatial orientation, and navigation. Such procedures are particularly applicable when the pilot flies his aircraft under conditions of instrument flight rules (IFR).

This complexity of instrumentation places heavier demands on a pilot's intellectual and physical resources than in former years, when cockpit instrumentation was much simpler. It follows that the aviator, with more instruments before him, is able to devote less attention to each than formerly. The pilot will also become fatigued earlier because of the greater demands on his intellectual and physical resources. This fatigue might have a direct bearing on his ability to perform his mission properly.

Efficiency of the man-machine system in an aircraft is directly related to the ability of the pilot. Improvement of this human element can be obtained by selecting and training the best qualified men and by ensuring that they have the best equipment. The best man-machine coupling, that is, the device or devices that enable man to operate the machine, will improve the performance of the system, and ultimately will have desirable effects on the tactical performance of the aircraft.

Achievement of the most ideal coupling between man and machine has been the long range objective of the Joint Army-Navy Aircraft Instrument Research (JANAIR) task, formerly the Army-Navy Instrumentation Program (ANIP). One particular way in which substantial gains might be made is through optimal use of integrated displays of a pilot's instruments that permit him to use them as a totality.

In inclement weather, for example, when an aviator must fly entirely by instruments, he can tell that his aircraft is in an improper attitude only after it has already started on this course. He determines this—after the fact, so to speak—by intently watching his instruments, which tell him the change has taken place.

With the Advanced Army Aircraft Instrumentation System (AAAIS), the pilot will have a horizon and essentially the same visual cues directly before him in the cockpit in picture form as he

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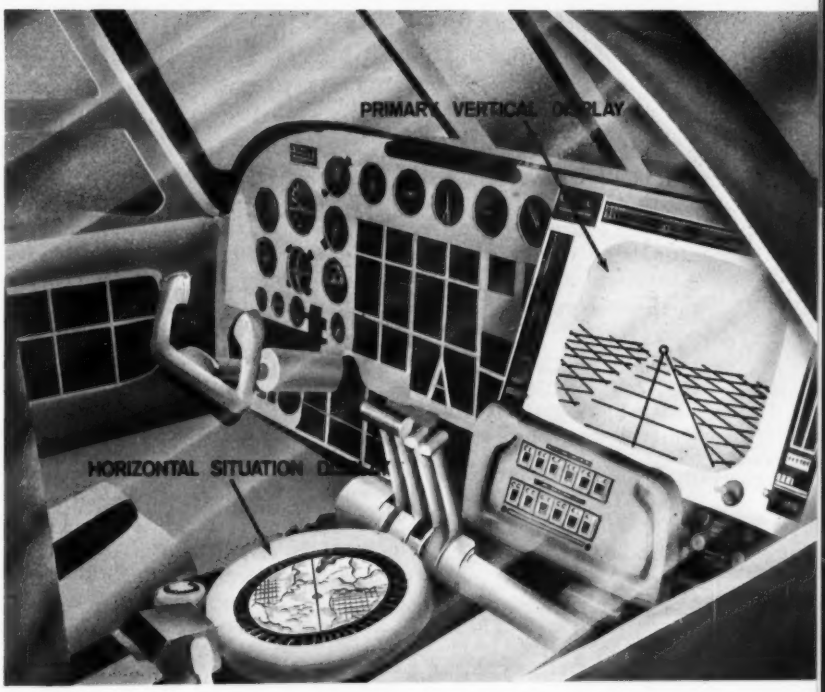
Mr. Dworzak is the civilian project engineer on the AAAIS project at the U. S. Army Electronics Command, Ft Monmouth, N. J.

would find in visual flight conditions on a clear day. AAAIS will provide a better man-machine coupling through this contact analog display together with a horizontal situation display. For evaluation purposes, AAAIS will be installed in a commercial equivalent of the U-8D Seminole airplane. This display system will be applicable to a wide variety of high low performance aircraft.

The AAAIS is intended to accomplish the following objectives:

- Reduce for the pilot the number of mental calculations required by abstract displays associated particularly with flying during instrument flight rules (IFR) conditions.
- Reduce the pilot's computational workload in solving navigation and fuel management problems.
- Improve the flight data acquisition rate.
- Provide a self-contained, all-visibility, low-altitude flight capability.
- Ultimately replace many of the conventional cockpit instruments through a consolidation of functions of various instruments into a single system whenever possible.
- Present an integrated picture display of flight and navigational information that is readily assimilated by the pilot.
- Allow for growth of the system through such new components and devices as will attain the major currently established system objectives plus those that may be established in the future. These objectives may require such additional techniques as low-light-level television and infrared when the appropriate sensors are fully developed, plus self-contained landing aids.
- Reduce flight and instrument training.

The major components in AAAIS are: (1) displays (vertical display, horizontal display, auxiliary displays, display generator, and map scanner) and (2) a computer complex (central digital computer and air data computer).



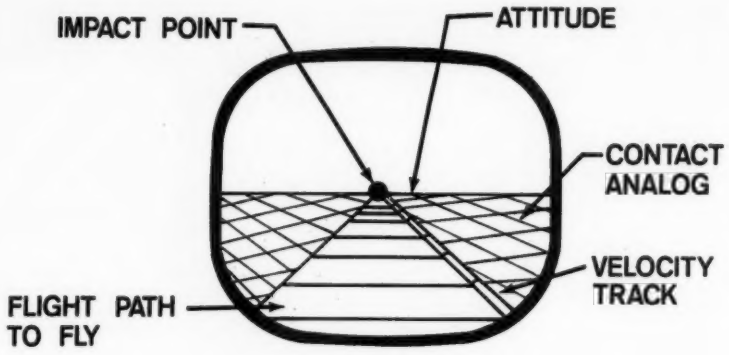
Cockpit mockup of Advanced Army Aircraft Instrumentation System (AAAIS) in typical cruise mode

Vertical Display

The vertical display, which will be located in front of the pilot, looks very much like the face of a standard household television tube. It will show a constantly changing, artifically generated picture of the simulated world in front of the aircraft, as if the pilot had a window in the instrument panel instead of the tube. In a realistic manner, this picture will show a horizon above which a scattering of clouds will appear in the sky. Below, a simulated ground pattern will appear in perspective.

The remarkable feature of this display is that the pilot will see this representation of the real world *even if he is flying in a rainstorm or heavy clouds,* and whether flying during the day or at night. Since he will need to contend with only one type of flying condition, his job will be made easier.

This realistic picture will sharpen certain impressions upon the human sense receptors; in this case, the eyes. The picture will be varied in contrast as a function of range, with the least contrast (between light and dark) near the vanishing point. The pilot will have an impression of forward motion because various elements of the picture, starting at the vanishing point, will seem to be moving toward him, just as objects in the sky or on the ground do when he observes them through his windshield on a daytime flight under visual flight conditions. If the aircraft moves up or down, or



Primary vertical display

turns, these movements will cause a corresponding change in the picture, and the pilot will encounter a visual sensation similar to that experienced during normal contact flight.

The vertical display also has a broken line along the right edge of the flight path pattern which is called the speed marker. When the airplane is flying below the desired speed, the speed marker will appear to move away from the pilot; when the plane is flying above the desired speed, it will appear to move toward him.

Horizontal Display

This display itself is a flat 7 inch diameter two-gun cathode ray tube (CRT). The display presents a picture of a map with a small figure of an airplane which shows the relative location of the aircraft to geographic features and a course line. Terrain avoidance or radar mapping information may be simultaneously displayed along with the navigational map, course line, fuel range circle and present position symbol.

The display presents a topographic map using universal transverse mercator coordinates for the terminal areas and lambert conic projections for the en route and master maps. The map is projected from one of 394 frames of 70 mm film which is scanned by a vidicon camera located in the aircraft. At any time during the flight, either the fixed map or the moving map mode can be selected. These selections work as follows:

Fixed map: On the horizontal display the aircraft symbol moves toward the edge of the display. When the aircraft symbol approaches the edge of the display, the map and the symbol appear to jump back to the opposite edge. The cycle is repeated as long as the fixed mode is retained.

Moving map: In this case, the symbol remains fixed on display while the map moves beneath it. The horizontal display will use maps which cover an area as large as 800 by 800 miles.

An unusual feature of the display is the fuel-range indicator. A range circle will be centered on the small picture of the aircraft which represents the aircraft's present position. The radius of this circle will indicate the distance the aircraft can safely fly until its fuel supply is exhausted. This range will be based on the existing rate of fuel consumption and the amount of fuel remaining in the tanks.

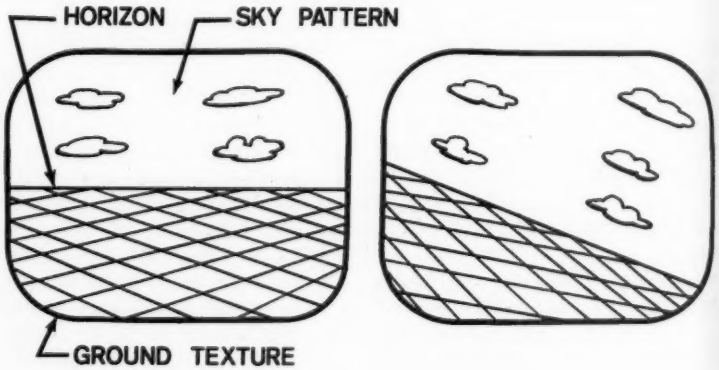
Display Generator

Simply described, the display generator is a transitional device that takes electrical impulses from various components generating parts of the pictures that appear on the vertical and horizontal displays, and mixes, shapes, and converts them into symbols that are projected in meaningful, coordinated and complete pictures. The types of video which are mixed and shaped include vidicon pictures, electronically generated symbols, and converted radar video.

Auxiliary Displays

AAAIS auxiliary displays include a vertical tape airspeed instrument on the left side of the vertical display and a vertical tape altitude instrument on the right side of the display. Digital read-

Vertical displays before flight path course and flight attitudes are selected, with airplane in two different attitudes



outs of present and command airspeed and altitude are included in these instruments. The AAAIS fuel management panel presents digital readouts of miles of fuel remaining, minutes of fuel remaining, miles to go, and minutes to go. Manual input controls are included for magnetic variation, command terrain-following altitude, wind velocity and direction, vertical rate, initial fuel quantity, and glide-slope angle. Each control has digital counters for manual set-in by the pilot.

Central Digital Computer

Data processing and computations required for the display system are performed by a central digital computer. It accepts inputs from the sensor equipment and provides outputs to the display equipment. Its functions include:

- vertical display symbol displacement commands,
- horizontal display symbol displacement commands,
- navigational computations,
- fuel management computations,
- auxiliary display commands.

The computer is a combined incremental and whole number, general-purpose computer designed to solve real time problems associated with the navigation of airborne vehicles.

Map Scanner

The map scanner makes available to the horizontal display, maps which are located outside the immediate cockpit area.

In the present system, map coverage is available over an area of approximately 800 by 800 miles in the eastern portion of the United States at two map scales—1:250,000 and 1:1,000,000. At a scale of 1:62,500 120 frames are selected from a 100-mile corridor covering the area between Sandy Hook, N. J., and Johnsville, Pa., and extending down to the Gulf

AAAIS is designed to simplify cockpit instruments and make flying easier and more exact

Coast south of Huntsville, Ala. The tactical utility of the 1:62,500 scale, however, has yet to be determined for fixed wing operation.

For rotary wing aircraft, the map scales may vary considerably from those for fixed wing aircraft and are yet to be determined. In any event, maximum coverage will probably not be much greater than 250 by 250 miles.

Airborne Terrain and Obstacle Avoidance System AN/APN-149 (Modified)

Because of progress in potential enemy air defenses the likelihood of aircraft surviving in or near enemy held areas is greatest in low level flights. These are preferable even at night and during nonvisual conditions of rain or fog to avoid detection by enemy warning systems and increase the opportunity for surprise.

During conditions of good visibility, the pilot is able to guide his flight at low altitudes by careful attention to terrain features. However, at night, or in fog or rain, there is a different and challenging problem. Obstacles cannot be seen and consequently must be anticipated and avoided. To do this, the pilot normally is forced to fly at higher altitudes—sufficient to clear these known obstacles. At these higher altitudes, however, there is increased likelihood of being exposed to enemy detection devices, and to weapons integrated with these devices. Experience shows that the probability of pilot fatality rises sharply under these conditions, whether the aircraft is over enemy territory or friendly territory close to the forward edge of the battle area, since enemy detection devices and weapons such as ground-to-air missiles now reach far into friendly territory. The AAAIS terrain avoidance radar senses the terrain features in front of and below the aircraft flight path and commands the pilot to pitch up or down in order to maintain a constant ground clearance by means of the command flight path on the vertical situation display. Valleys, mountain passes and other terrain features may be presented in the form of a plan position indicator (PPI) scan for the pilot's use on the horizontal situation display.

Voice Interrupted Priority System

The pilot's instrument scan pattern is further reduced through the use of an auditory emergency or caution warning system, relieving him of the constant need to scan engine and electrical system instruments. The AAAIS Voice Interrupted Priority System (VIPS) has the capacity of 20 prerecorded warning messages. Should more than one emergency or caution situation arise at the same time, the warning message with the highest priority will be heard first. After the pilot takes corrective action or overrides this message, then the second highest priority warning is heard.

The specific AAAIS system discussed is of recent origin. The U. S. Army Electronics Research and Development Laboratories prepared a proposed qualitative materiel requirement for it on 20 November 1961. A fixed wing system was flight tested by the contractor early in 1965 and delivered to the Army in February 1966. The Electronics Command's Avionics Laboratory is currently evaluating the system.

Let's Standardize

Captain Clarence O. Bakken

I WONDER HOW many accidents, incidents, or near accidents have been caused because of nonstandard cockpit configurations. I know of a few, but I'm sure many more are undetected and unreported.

Consider the guy who's been flying knot indicators and finds himself with a mph indicator without realizing it. He just took off and wonders why the machine won't fly just right at 60.

Conversely, what could happen to an aviator coming into a short strip with a knot indicator, thinking he was making his approach at 65 mph? Get out your E6B and you'll find this is 75 mph. Now refer to your −10 and compare the difference in landing distance between 65 mph and 75 mph.

Now let's get into an O-1. Yes, everyone knows the O-1 but think of the differences in the models. The E and D models have their switches on the left while in the A model they are right in front of you. Not many more manual flap handles around anymore, but that's another difference. There are these obvious differences plus the many different conglomerations of gauges and gauge locations.

Then there was the time I got into an OV-1 with an old starting panel. On the new ones that I was used to, you hit the starter switch and after 10 percent you press the ignite button. Now on the old panels the switches are in exactly the same arrangement except what is now the ignite button used to be the interrupt crank. After waiting for my 10 percent two times, hitting the ignite button, and watching the percentage drop to zero, I remembered which machine I was in. How embarrassing—because then I had a dead battery and had to call the crewchief with an APU. And to top it off, I was an instructor in the Mohawk.

So far I have just mentioned differences in models of the same type aircraft. Now we get into the real meat of our problem. Most aviators sometime during their flying career are in a position to fly a wide variety of aircraft. You might have missions in a fixed wing (s) and a helicopter (s) within the same day.

I'm sure each of us has run into this type situation, and 364 days out of the year it is no problem. But what about that one day when you're not thinking quite as well as usual? You've been flying the Otter consistently, and after a short mission you come back to find yourself scheduled for a Beaver mission.

After a good preflight you crank up and roll out to the runup area. As you pull into position you reach down to the left to set your parking brake. Oops, something's wrong. The parking brake won't pull out. Then it hits you. You're pulling on the clutch. Thank goodness, it was properly locked!

One way to minimize this problem is to use checklists, but they aren't always readily available in emergency situations. We can also minimize the problem by continually reviewing the −10s of the various aircraft in which we are rated, but sometimes additional duties such as desk flying may make this rather impracticable. We can also concentrate on flying each and every time we get behind the controls, but sometimes we have other things on our minds without realizing it. The inherent problem could be minimized by flying only one type aircraft, but sometimes mission requirements preclude this.

If we standardize our cockpits so that the same type instrument and knob (if required) is in the same place on all aircraft, then inadvertent moves caused by habit may be almost nonexistent. Could something like this make it easier to keep up with different types of aircraft? But most important, would it make it safer?

Capt Bakken is Project Officer, Operations Branch, Dept of Maint Tng, USAAVNS, Ft Rucker, Ala.

Jack S. Harrison

The prospect of learning to fly is still exciting and glamorous. To keep this enthusiasm high, the instructor must realize that how he teaches is as important as what he teaches.

Successful Flight Instructors

SUCCESSFUL FLIGHT instructors employ inflight demonstrations to show the operation or use of the aircraft. Student learning is greatly increased during inflight demonstrations, which more than compensates for the time used in their planning and application.

Should inflight demonstrations be designed to show the wrong way? In answering this question, let's examine some learning fundamentals which are related to demonstrations:

- Instructors teach by showing (demonstrating) and telling (explaining). Students learn through seeing and hearing.
- Instructors teach by directing student practice. Students learn by doing. Doing is one of the most effective ways of learning.
- Instructors teach by constructive criticism of student errors.

To bring about student learning, criticism must be sandwiched between many statements of praise. A ratio of 90 percent praise to 10 percent criticism works well with the average flight student. Instructors should give each student at least one sincere compliment a day, in addition to the criticism.

Why should flight instructors use inflight demonstrations?

Demonstrations illustrate correct methods. They *show* the student how to do it; and showing is usually a more effective teaching technique than merely telling. Demonstrations are most effective when instructors use *comparison* and *contrast* to illustrate teaching points.

Inflight demonstrations set standards of performance. They make a strong impression on the student. To hold a student's respect the instructor must strive to perform demonstrations of the highest quality, better than the

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Mr. Harrison is a civilian flight instructor at the U. S. Army Aviation School, Ft Rucker, Ala.

student can perform. A demonstration will also give the student confidence in his ability to attain the skill.

Let's apply what we have learned about demonstrations to a flight training program.

In our problem the student used too much bank turning final in power approaches, risking an accidental stall close to the ground.

Two flight instructors handled the student differently in trying to change this unsafe approach procedure.

The first flight instructor showed the student what he had been doing wrong: he demonstrated the steep turn to final. He then said to the student, "Don't use a steep turn to final. If you do, you run the risk of an accidental stall which is dangerous when close to the ground. Instead, use a gentle bank and start it earlier than you have been starting it."

The second instructor demonstrated, at a safe altitude, the way the student had been making his approach. He exaggerated the student's excessive bank approach slightly to obtain a stall, while at the same time directing the student's attention to the degree of bank. Then the instructor demonstrated a correct approach and mentioned the advantages of a shallow bank. Realizing that the student might sometime get in a position requiring a steep bank, he demonstrated the correct procedure for avoiding a stall: adding power and lowering the nose.

Which of these two flight instructors used the best inflight demonstration techniques? In answering the question, let's briefly discuss each of the techniques.

The first flight instructor demonstrated only the wrong way of making the power approach. Although he *told* the student how it should be done, he demonstrated only the wrong way. It is extremely likely that the student will remember the demonstrated way only and not change his method of making the approach. In this case the instructor has not achieved his objective of changing either student method or concept of a safe power approach.

The second instructor used more effective techniques. Initially he showed the student the incorrect method with its disadvantages (the stall stressed the fact that this was obviously incorrect). Then a correct approach was shown, stressing the shallow bank. The instructor also demonstrated how to compensate for a steep bank (by adding power and lowering the nose) when a steep bank was unavoidable.

Of course the second instructor used the best demonstration techniques. He gave the student an opportunity to compare the two approaches. To the student, seeing was believing. The excessive bank and resulting stall contrasted greatly with the gentle bank and safe approach.

Here are some other important points for instructors to remember about demonstrations:

• Students with limited background usually accept instruction without question. The word background here refers to the student's total experience level, including his age, education, and training.

Instructors teach by directing student practice

Students learn by doing—one of the most effective ways of le

• Students with extensive background may question or challenge what they see and hear in demonstrations, at least subconsciously. To make demonstrations effective it is imperative that the student have confidence in the instructor's knowledge.

So far, we have discussed demonstrations with only brief mention of explanations which may accompany demonstrations. What can instructors do to make explanations effective in flight training?

Explanations, of course, must be clear and correct. Equally important, however, is the instructor's speaking attitude. It must be sincere, enthusiastic, and confident.

A sense of humor is another desirable characteristic. Humor is most effective if the instructor can exploit spontanteous incidents which occur in the student's training. A sense of humor makes the instructor a warm person.

Enthusiasm, or interest in the procedure, is important. Some instructors are enthusiastic in a quiet way. Others are vigorous and dynamic in their explanations. Either way the instructor's interest in the procedure must be strong and must show.

When demonstrating, confidence in the speaking attitude springs from knowing the flight procedure thoroughly. The instructor has belief in his ability to speak and control nervousness. It is through training, study, and research that he gains knowledge. It is through practice and experience that belief in this ability to speak and demonstrate comes. In any event, knowledge and belief are up to the individual instructor to accomplish in his own way.

An instructor must naturally pay attention to details in his explanations. Of the same importance, though, to the overall quality of his instruction is the basic attitude which he developes in the student. These the instructor should strive to bring about through continuous motivation of the student. What is said to the student and how it is said is very important.

We have stated that sometimes it is best to demonstrate an incorrect method, but the correct way must be obvious or we must show the correct way later. We have emphasized proper speaking attitude in the explanations which accompany demonstrations. It should be characterized by sincerity, enthusiasm, confidence, and humor. We have mentioned the importance of developing the right basic attitudes in continuous motivation of the student.

The effectiveness of the American flying officer in battle is closely related to the quality of instruction he receives. That, incidentally, is why instructors are important.

Explanation must be clear and correct

e ways of learning

Praise as well as criticism is necessary to student learning

Armed CH-47A Helicopter Employment

Lieutenant Colonel Morris G. Rawlings (Ret)

MOST DISCUSSIONS of armed aerial platforms inevitably wander into a wall of concrete opinions expressed in terms of roles and missions. It surprises no one to find that wall disappear when operating personnel meet with a common enemy in combat. This article begins after the wall has disappeared and takes a close look at an armed version of the Army's CH-47A medium transport helicopter. It explores the development of the need, expression of concepts, and anticipated employment of the man/machine combination. A companion article ("Armed Chinooks," DIGEST, July 1966) presents data regarding the armor, armament, capabilities, limitations, and crew requirements.

In February of 1964, a "requirement" was established for the use of a heavily armed helicopter in combat operations. It was developed by those who know best—the men actually doing the fighting.

A requirement is a need. A need carries with it a variable degree of urgency for its fulfillment. It may be needed now; it may be needed next week or next month; its fulfillment may be postponed for an indefinite period by forcing some other man or machine to do double duty. A requirement does not disappear simply by being ignored. Its fulfillment may be postponed, but the requirement remains.

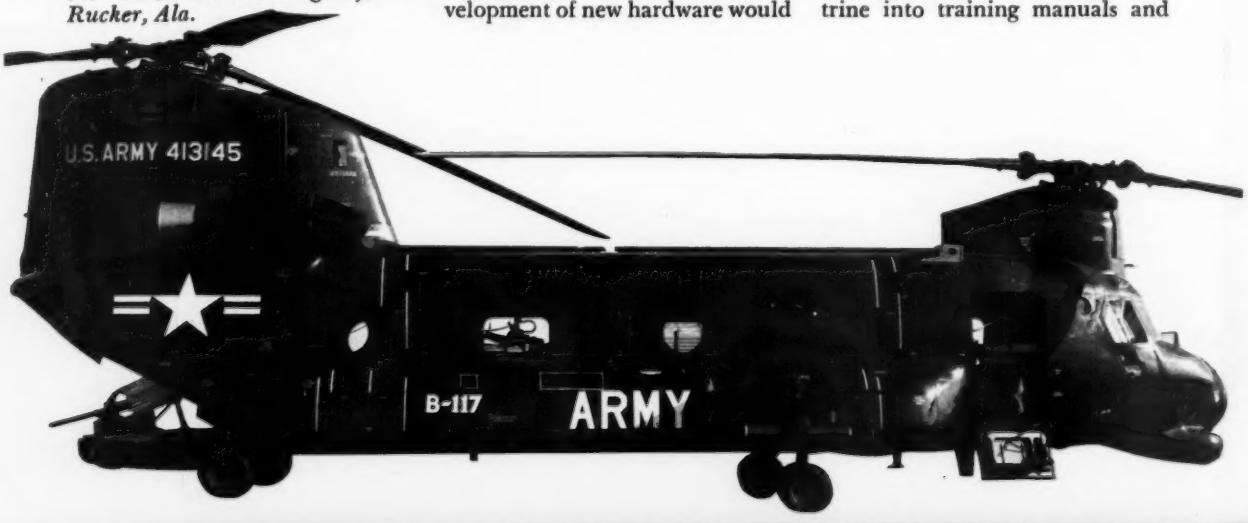
The Combat Developments Command has as one of its primary duties the expression of requirements in a formal and orderly manner. The Army Materiel Command has as one of its primary duties the development of equipment items needed to fulfill the requirements expressed. The process by which formal requirements and orderly equipment development is obtained is both time-tested and time-consuming.

By May of 1964 combat experience proved that the formal development of new hardware would take too long, that the urgent requirement demanded modification of existing equipment, or off-the-shelf procurement and adaptation. This determination lasted only until August. At that time a different interpretation was placed upon the urgency of the requirement—not on the requirement itself. Off-the-shelf adaptation or modification was temporarily shelved in favor of the time-tested orderly process.

In June of 1965 all doubts regarding the urgency of the requirement were removed. The Army ordered four modified machines (CH-47A) for delivery by the end of the calendar year for Army evaluation.

That is the history of the requirement. Had it been capable of development by standard processes, the concepts and doctrine would have been prepared and approved long before the equipment itself was available. The Combat Developments Command Aviation Agency would have had the opportunity to translate doctrine into training manuals and

Col Rawlings is a former director of CDO and deputy director of the CDC Aviation Agency, Ft Rucker, Ala.



programs of instruction. It would have caused the paper TOE to become an operational unit filled with trained and training soldiers.

This didn't happen.

It has yet to happen. Development by an orderly, though distinctly nonstandard process, requires that the documentation of concepts and doctrine be concurrent with the publication of training documents and their use by training crews; and that the evaluation of the equipment as a manufactured item be concurrent with its evaluation as a tactical tool.

To combine concepts and doctrine with the publication of a training manual, the Combat Developments Command directed the early (December 1965) completion of a training text, and assigned the project to the CDC Aviation Agency. The preparation of a training text presupposes, among other things, that the authors have a knowledge of the tasks to be performed; the environment and conditions under which the tasks will be assigned; the capabilities and limitations of the man/machine combination to perform those tasks under those circumstances; the organization and level of assignment of the unit to be trained; and the unit's total requirements in terms of maintenance, supply and service.

No individual and no single agency possess all the knowledge required for such an undertaking. The most cursory of research efforts will quickly disclose a fragmented doctrinal literature, disclosing differences in the employment of the armed helicopter as expressed by the combat arms. A draft field manual, prepared by the U. S. Army Aviation School in October 1965, attempts to reconcile all differences and offers a welcome point of departure. Because the armed CH-47A helicopter is simply an armed helicopter with increased capabilities for fire support through weapons choice and ammunition supply, a training document written for it should account for all the tasks which all the combat arms anticipate for all types of armed helicopters. From this listing, it should be possible to determine those best done by a heavily armed machine and thus emphasize the type of training necessary.

Fourteen tasks were anticipated by the combat arms. The first six relate to the escort of airmobile movements; the next four, to reconnaissance and security; and the final four, to fire support.

- Assist in the penetration of enemy front-line defenses by fire.
- Protect troop carrier aircraft en route to and during landing operations.
- Sanitize the landing area before touchdown of troop carrier aircraft.
- Assist in the protection of airmobile forces from enemy fires originating at or near the perimeter of the landing zone.
- Protect troop carrier aircraft operating within the objective area, or departing the landing zone for return to safe areas.
- Protect logistics resupply aircraft entering and departing the objective area.
- Precede air/ground column as an element of the advance guard, or succeed the covering force as an element of the rear guard.
- Assist in furnishing perimeter security to isolated forces.
- Assist in furnishing flank protection and/or gap security to engaged forces.
- Assist in furnishing rear area security to logistics installations/forces.
- Extend the fires of emplaced ground weapons (on call or on station).
- Thicken (augment) the fires of emplaced ground weapons (on call or on station).
- Attack targets of opportunity requiring a rapid response (on station).
- Ambush mechanized columns (on call).

These are described as tasks, not missions. The crew and the armed helicopter have but a single mission: to help the ground commander attain his objective. Many tasks are not applicable to a specified conflict intensity. There will be differences in tasks assigned and in frequency and priority of assignment, but the noticeable difference will be in the tactics and techniques used during task performance. Low intensity conflict places both frequency and priority of assignment on tasks related to the escort of airmobile forces; an increased intensity tends to emphasize the fire support effort. Perhaps this statement is deserving of more specific evaluation!

Tasks performed in the fire support role are, throughout the spectrum of warfare, the most frequently assigned and the most important.

Tasks performed in the reconnaissance and security role are,

ADMIN DUTIES

throughout the spectrum of warfare, more frequently assigned but of less importance than tasks performed in the escort role.

Tasks performed in the escort role are, throughout the spectrum of warfare, less frequently assigned but of greater importance than tasks performed during the reconnaissance and security role.

At first glance this evaluation appears to oppose established Army policy—a policy which emphasizes the escort role for armed helicopters. No such opposition is intended; nor is any present. In that intensity of conflict which permits the predictable and planned application of graduated force, the escort role is dominant. The evaluation considers a more uncertain future, and would hope to avoid a later nonstandard processing of requirements through anticipation.

In the foreseeable future, not everyone will be able to ride to work in an aerial vehicle, but everyone in contact with the enemy will accept supporting fires —often, and from any available source!

If the evaluation has merit, then the expressed requirement for the heavily armed helicopter is primarily for fire support. Additional speed, unless required for survivability (an unproved surmise), is not a part of the requirement; nor any other attributes peculiar to the escort role. Training literature should emphasize the use of the armed helicopter in the performance of the last four tasks listed—particularly should the uncertain future follow in the footsteps of expectancy rather than hope.

To proceed from the general to the specific, the mobile aerial weapons platform will be used chiefly as general support artillery. As such, it will be used to thicken and extend the fires of emplaced ground weapons; to attack those targets, the decay rate of which will not permit time for adjustment of artillery weapons or target identification for high-performance aircraft; and to establish or protect against ambush.

The CH-47A will operate in fire teams consisting of two aircraft. One will furnish a base of fire while the other maneuvers into an advantageous attack position. The fire team need not consist of two CH-47s. For those tasks concerned with reconnaissance and security, or those concerned with escort, a more appropriate team is formed by a mixture of light and heavy weapons helicopters.

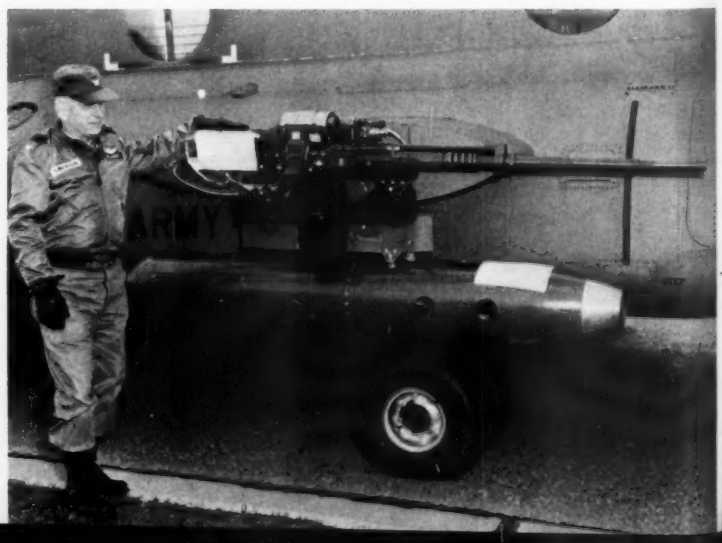
An analogy may be drawn from that naval array which finds the heavy firepower in the center of a screen of destroyers and destroyer escorts.

Night operations will become increasingly frequent, and will require heavy training emphasis. Attack attitudes, originally above effective small arms fire, will lower as enemy crew-served antiaircraft weapons increase. Targets will become more numerous, and inadvertent target overflight will cause the expenditure of large amounts of self-protective ammunition as well as increase the demand for safety harness and flak seats. Intentional overflight will not be practiced by the CH-47A, and multiple passes, if required, will be from changed directions and altitudes from stand-off positions.

Tactical employment of the heavily armed CH-47A presents nothing new in startling development or radical departure from present fragmented concepts and evolving doctrine. It simply recognizes that mobility and firepower are two sides of the same coin: that gaining in one at the expense of the other is a form of cannibalism. The Chinook has little or no mobility advantage over existing armed helicopters. That is not the requirement. Because it can carry self-protective, area suppressive, and a point target weaponry on the same airframe; and because it can sustain the firing of those weapons for a longer period of time because of its ammunition-carrying capability, it does have a distinct firepower advantage. That is the real requirement.

C-47 or CH-47A — everything needs to get into the shooting act, and the sooner, the better!

External armament includes one M-24A 20 mm gun and the XM-159 rocket pod (or 7.62 mm mg) on each side



HOW DO YOU USE YOUR AVIATION SAFETY OFFICER?

Major William J. Lumpkins

DEPARTMENT of the Army has recently established MOS code 7423 outlining the duties and qualifications of an aviation safety officer. It provides specific definition of the duties to be performed in TOE and TD spaces where a full-time safety officer is required.

Safety, as has been stated many times, is the business of everyone and not just that of the safety officer. Some units are authorized TOE safety officers; however, a sound safety program is still the primary responsibility of the commander along with his myriad other responsibilities.

Many commanders breathe a sigh of relief and feel that their safety program is solved when a school trained safety officer is assigned to their unit. In this atmosphere, the aviation safety officer immediately becomes the president of accident boards, the unit safety officer, and receives countless other additional duties that prevent him from performing his primary duty in the aviation safety field.

Some aviation units at various times have had several school trained aviation safety school graduates in their units. But guess who was in the aviation safety officer's job? That's right, the job was filled by a non-safety school graduate while school trained individuals performed various other tasks. An individual does not have to be school trained to do a fine job in the safety field; however, when you have a better qualified individual, you are money ahead to give him the task of running your safety program.

Your aviation safety officer should be used as your safety advisor and should review your accident investigation reports and make appropriate recommendations to improve unsafe conditions and to prevent recurrence. It is perfectly logical and recommended to use him as an advisor to accident investigation boards, but he should not be a member. *Have you misused your aviation safety officer?*

Maj Lumpkins is Aviation Safety Officer, Seventh Army, U. S. Forces, Germany.

Many publications have delineated the duties and responsibilities of the aviation safety officer and agencies with which he must coordinate. DA Pamphlet 95-9 is one of the guides that should be followed. Additionally, USABAAR has published several checklists for safety. One of these the Commander's Aviation Safety Checklist, included in the Aviation Safety Planning Guide, is the most complete and comprehensive document available to aviation units.

Your safety program should be designed to prevent accidents, while the aircraft investigation board's purpose is to find the cause of the accident and recommend procedures that will prevent the same type of accident from recurring.

As a commander, you can advance safety in Army Aviation by:

- Ensuring that the primary duty of your safety officer is aviation safety.
- Using your aviation safety officer as an advisor to aircraft accident investigation boards.
- Not overloading your aviation safety officer with additional duties that will prevent him from performing his primary duty.
- Recommending that TOE positions for an aviation safety officer be added in aviation units of company size or larger.
- Ensuring that the safety officer position is filled by a qualified individual.
- Providing job continuity in the safety position.

Remember, aviation safety is individual and collective—yours and ours.

This article does not necessarily reflect the views of the Department of Fixed Wing Training, USAAVNS. It is intended only to present the thought-provoking views of three instructor pilots.

Aviation Career Course?

Major Ernest E. Varney, Captain Arlie Deaton, and Lieutenant James W. Martin

THE CONCEPT of airmobile operations and the development of the armed helicopter brought about by our operations in Vietnam have greatly increased the Army Aviator's need for advanced knowledge of aviation operations. No longer can the aviator be satisfied with flying proficiency, knowledge of the capabilities and limitations of his aircraft, weather, flying safety, etc. Now, in addition to being familiar with all things associated with flying, the professional Army Aviator must have a good working knowledge of the tactical employment of Army aircraft.

Introduction of the armed helicopter to the conflict in Vietnam has greatly enhanced the important role Army Aviation is serving in the Far East. In any game or war, whether it is football or World War II, no matter how large or small the operation, good sound tactics have always been and will continue to be the deciding factor. Good tactical employment of the helicopter as a flying weapons platform, coupled with employment of other Army aircraft, has caused many battles in Vietnam to be decided in our favor. If our young aviators have sufficient training in aviation tactics before going to the Far East, we will be assured of continuing success in Vietnam and possibly even a higher degree of successful accomplishments.

Army Aviators must work with and around the ground gaining troops. This takes considerable coordination in communications, fire support, and all areas of planning. Since the war in Vietnam is a dynamic, fast moving, nonconventional type war fought in the jungle, it is very important that the combat troops be able to shift

Maj Varney, Capt Deaton and Lt Martin were assigned to the Dept of F/W Tng, USAAVNS, Ft Rucker, Ala., when they wrote this article.

from one position to another rapidly. They cannot do this with ground vehicles because of dense jungle growth and lack of roads. Therefore, the only answer left is to accomplish the mission with aircraft. In addition to solving the transportation problem, the helicopter is also a fine weapon of war when employed properly. Even as the flying and employment of troop-carrying helicopters is a skilled art, tactical employment of armed helicopters is an even greater art. Both take many hours of training and a good working knowledge of aviation tactics.

The increasing requirement for aviators in Vietnam has prompted the Department of the Army to temporarily suspend ground duty for commissioned aviators. This now leaves open the possibility of a re-evaluation of current career schooling required for commissioned officers on flight status. It is well understood and fully accepted that the Army will probably never introduce an aviation corps or separate branch. Also it is fully realized that all commissioned officers, whether on flight status or not, are required to maintain branch qualification. This point is not contested at all. The thought that is brought to mind is the possibility of paralleling, but not duplicating, the present branch schooling.

It is generally agreed that being a professional in any field is a full-time job. The commissioned aviator normally has the initiative, drive, and ability to be a true professional in both his basic branch and as an aviator. Each branch of the Army has established service schools and career courses to aid its commissioned officers in being true professionals. Why shouldn't the commissioned aviator have a career course to assist him in being a true professional aviator as well?

Presently, the commissioned aviator is required to attend a career course of his basic branch or a comparable course of one of the other branches. These courses are normally from 5 to 9 months in length. To maintain a satisfactory standing in his class, any officer must apply himself vigorously to the task at hand. For the Army Aviator this leaves little time to maintain aviation proficiency. This results in the aviator falling below his desired level of proficiency and does not permit him to stay abreast of current aviation doctrine.

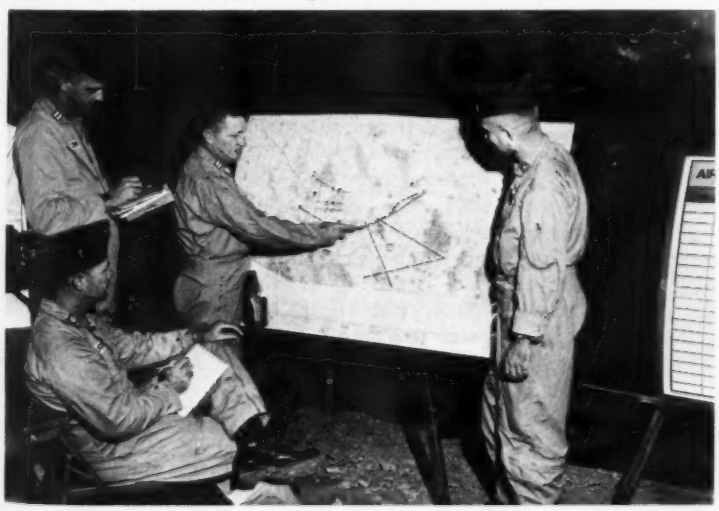
Instruction received in the present branch school provides the aviator with the technical knowledge required of him by his basic branch. Generally speaking, the branch career course provides instruction that ranges from maintenance of equipment and ground vehicles to tactical employment of a brigade or larger size unit. The instruction also includes logistics, personnel action, employment of nuclear weapons, intelligence, leadership, and other branch related subjects.

While it is agreed that the commissioned aviator should have a basic and general knowledge of the mission and employment of all ground gaining arms, we believe that his technical knowledge should be oriented toward the tactical employment of Army Aviation.

Presently, branch schools are offering insufficient instruction along this line. The instruction offered is quite sufficient for the ground commander, but for the aviator it leaves a lot to be desired. The ground commander expects the commissioned aviator to be as much a professional aviator as he is a ground officer. Therefore, he depends heavily upon the commissioned aviator to advise him in the employment and use of Army aircraft. Army Aviators need to become as well versed as possible with all aspects of aviation and the tactical employment of Army aircraft. A course of instruction along these lines would greatly assist the aviator in meeting his professional requirements.

Many subjects such as regulations, administration, training maintenance, logistics, tactics and safety are directly related to avia-

Aviators must be well versed in all aspects of aviation



The ground commander expects the commissioned aviator to be as much a professional aviator as he is a ground officer

tion and are currently encountered by the aviation officer only after he is assigned to a position requiring his supervision or assistance in these matters. Before this time, he has little or no working knowledge of these subjects. His education dealing with these all important aviation topics are on a hit-or-miss basis determined by his duty assignments.

It is conceivable that a given officer may serve his company grade career at the controls of a Bird Dog or Beaver in an aviation company and never be exposed to situations that would enable him to answer such questions as: How many troops can we plan on transporting in our CH-47? Can we ferry a 105 with the CH-34? Will the OV-1 be able to fly the mission in this weather? Our aviator cannot answer these questions. He has no idea whatsoever, unless of course he has had the fortune of serving in units of this type. If so, he will probably impress you with his knowledge of the subject matter. You would rate him outstanding. If so, for the same reason, you would expect an infantry commander to rate his newly assigned aviator-officer, poor Captain Bird Dog, as unqualified.

It is easy to summarize this situation by saying a fortunate aviator would be one who is lucky enough to have served in several varied positions. As we all know, assignments are made without the knowledge or consent of the individual. They are usually made on the basis of filling a given slot that exists when the aviator is up for reassignment. So, by being in the wrong position, the aviator who will someday be expected to exercise command authority or serve as an aviation staff officer could be unqualified.

This qualification must be achieved by other than "driving an airplane" or on a hit-or-miss experience basis. This must be accomplished by a formal school that covers these subjects in a detailed program of instruction. The basis for this school is simple: If we expect him to know, then let's educate him in the principles.

Lessons learned in Vietnam could serve as a basis for tactical instruction in the course. Maintenance of flight proficiency and meeting annual or semi-annual flight requirements could be incorporated in the course of instruction. The course would also serve as a refresher in weather, aircraft maintenance, and other aviation related subjects. Also this would be a great opportunity to re-emphasize safety, a vital subject for the Army Aviator.

In addition to normal technical and tactical instruction, the course could also provide instruction and training in survival behind enemy lines. This is a necessity for aviators in a combat situation. Recovery of downed aircraft could also be included in the program of instruction. Instruction could be given on actions required of the recovery party and those actions required of the personnel at the downed aircraft. The tactical use of pathfinders is another area that is presently not included in the branch career courses.

A very critical area of airmobile operations is the detailed planning that goes into each operation. This planning includes the areas of logistics, aircraft movement, loading zones, enemy SITREPs, troop briefings, objectives, alternate courses of action, weather, communications, availability of aircraft and crews, and coordination with all other airborne operations and agencies.

The Aviation Staff Officers Course at Fort Rucker, Ala., approaches the course recommended. However, this course is only 3 weeks in length and just briefly touches on the subject areas recommended above. If this course could be extended to approximately 4 months, it would allow for detailed instruction in all subject areas mentioned. This would very adequately serve as the recommended career course.

One of the arguments against such a course is that it would increase the amount of time spent in school or training by a commissioned officer. This is very true. However, by extending the already established Aviation Staff Officers Course, some of the time required could be eliminated. As for the additional 3 months of training, this is a very small sacrifice to make if we obtain a much more capable and professional aviator as the end product.

Another argument against this course is that of advocating the establishment of an Army Aviation Corps or separate branch. This is not the case at all. It is merely implied that with the large number of aviators and aircraft in the Army inventory today, additional training in the employment of aircraft is necessary.

As previously stated, being a professional is a full-time job. An increase in the training made available to the Army Aviator will raise his proficiency level and improve his value to the Army. It is our responsibility as professional Army Aviators and as commissioned officers to constantly evaluate our aviation program and recommend changes as necessary to maintain the highest level of professionalism possible.

ENGINEERING APPROACH TO LIGHT TWIN OPERATION

Author Jones (front cockpit) prepares for jet flight in FAA T-33

It is our belief that any of today's airplanes will do an excellent job when flown with a knowledge of, and respect for, its limitations . . .

John Paul Jones
Chief, Engineering & Manufacturing Training Branch
Federal Aviation Agency Academy

THE FAA ACADEMY, located at Will Rogers World Airport, Oklahoma City, Okla., has as its primary function the training and standardization of FAA personnel in FAA work. This is accomplished through teaching courses based upon all the areas of activity in which FAA personnel function. The largest segment of this training program is associated with the training of the multitude of electronic engineers and technicians who design, install, operate, and maintain the myriad electronic

ENGINEERING APPROACH TO LIGHT TWIN OPERATION

Stearman trainer is used to teach and practice spin recoveries

Cessna amphibian is used for water takeoffs and landings

FAA stable includes Boeing 707

facilities scattered throughout the airways of the world.

Another major program is that for airways traffic control personnel. These are the men who control en route traffic from the great traffic control centers and also those who control local traffic from the airport towers. In the flight training program, we have a large stable of aircraft for the education of our own pilots, flight test engineers, and others concerned with the operation and airworthiness of the National Aviation System. In our group of aircraft we have one Boeing 707, one Lockheed Electra, one Convair 880, and many smaller aircraft such as light twins, helicopters, etc.

The Flight Test Section is a part of the Engineering and Manufacturing Training Branch, which is a part of the Flight Standards Training Division at the academy. This group conducts courses for personnel in the Aircraft Engineering, General Aviation, and Air Carrier Divisions from both our Washington and field offices. Most of the courses also accept observers from the aviation industry, from our own military organizations, from foreign airlines, and from the civil aviation agencies of many foreign governments. The Flight Test Section gives indoctrination training to new FAA test pilots and flight test engineers and conducts classes in special activities for older employees when new regulations or new procedures warrant.

In addition to training for our own flight test people, this group conducts classes for personnel from both the Air Carrier and General Aviation Divisions. These are courses in the fundamentals of flight test procedures and are designed to acquaint pilots with some of the engineering aspects of the aircraft they fly. We deal with both transport and nontransport category airplanes, as the needs of the particular inspector demand, and we lay great emphasis on the problems inherent in multiengine airplanes. We attempt to get in four hours of ground school as well as four hours of flight each day, since

Bell helicopter is used to practice placement of telephone poles

the philosophy behind the courses calls for operational problems to be discussed in the light of engineering knowledge of the airplane, and then for solutions to be tried out in flight.

We have never been able to agree with the philosophy advanced by some that training should never involve engine cuts, etc. It is our philosophy that no pilot should be permitted to take passengers into the air, and thereby subject them to the dangers which could follow an emergency, *unless he has previously been confronted with this emergency in training and has been taught to cope with it.* This concept pervades our training program.

I will confine this article primarily to some of the things covered in our course on light twin operation, since interest has been indicated in the problems of multiengine operation. Many of the things covered will, of course, also be applicable to other aircraft.

At this point, let it be clearly understood that our classes are not for the purpose of comparing one aircraft against another. It is our belief that any of today's airplanes will do an excellent job for its owner *when it is flown with a knowledge of, and respect for, its limitations.* Therefore, our courses are designed to teach the operating pilot how the aircraft's limitations were determined and to give him an understanding of the significance of these limitations in his normal flying. We have students actually determine the limitations of different aircraft and associate these with maneuvers done in their daily work.

A brief example of some of the items and their handling would be as follows – beginning with that very misunderstood term *Vmc.* Vmc can be defined as "the minimum airspeed at which the aircraft is controllable when the critical engine is suddenly made inoperative, with the remaining engine (s) at takeoff power."

The Civil Air Regulations say that, at this minimum speed, you must be able to do two things: First, you must be able to stop the turn which results when the critical engine is chopped and you must be able to stop it within 20° of turn. Second, you must be able to fly away on the new heading without holding the wing down more than 5° on the good engine side and without using more than 150 pounds of rudder force or full rudder if it is obtained first. (Note: The 150 pounds rudder force is for CAR 3 airplanes – those light twins weighing 12,500 pounds or less. In transport category, or CAR 4b, this value is 180 pounds.)

Since, at the same minimum airspeed, we must not only stop the violent turn immediately after engine failure but must also fly away straight, we naturally investigate the second item first. When testing for an unknown minimum control speed, it is much simpler and less dangerous to set the plane up at some relatively high speed, close the throttle on one engine with takeoff power on the others, hold a wing down 5°, and slow down to the speed at which you can just hold straight flight with full rudder–and to try chopping engines at this same speed later.

Several years ago, a special course was conducted for transport category pilots, using one of our DC-4s. It was designed to convince people that the performance figures in airplane flight manuals can be readily obtained by flying as the "book" directs. From this course, and many conducted since, we have learned a great deal–including the fact that many pilots of multiengine planes take off with their seat so far back that they could not reach full rudder in case of engine failure; and the fact that most pilots think primarily of controlling a plane, following engine failure, with the rudder. It has

ENGINEERING APPROACH TO LIGHT TWIN OPERATION

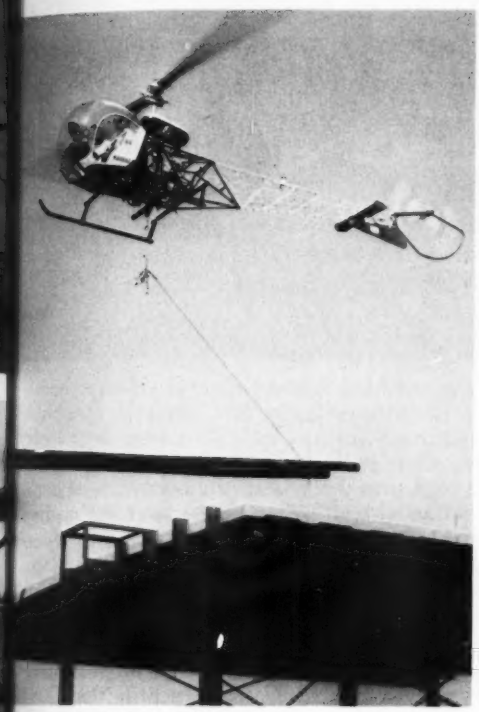
Bell is also used for practicing external loads . . . Schweizer 2-22 is used for glider training

been our experience that using the aileron against the turn — and using it immediately — is the real solution of the problem. Our courses emphasize this fact.

Since the requirement calls for takeoff power in determining Vmc, this usually presents a problem—particularly on sea level engines where full power is available at sea level only. At Oklahoma City, which is 1,300 feet above sea level, we normally conduct this investigation over the Canadian River flats, the lowest point in the vicinity. Many pilots insist that the aircraft which they have been flying has a minimum control speed a number of miles per hour below that specified in the limitations portion of their airplane flight manual, or owner's operating manual, as the case might be. We normally pursue this in discussions with them in the classroom and find that they are conducting the investigation at some altitude considered safe with relation to the elevation of ground in the vicinity of their home airport.

Since this home airport might be at any given elevation within the United States, it is obvious that they are normally considerably higher than sea level. We then explain how the limiting value in the limitations was established as a sea level consideration. This obviously presupposes that the figure would be lower at any distance *above* sea level. As a matter of fact, the minimum speed at which the aircraft is controllable, with an engine out, is a function of the imbalance of power. Since power is a function of altitude, Vmc will vary inversely with altitude. We then explain how the actual limitation was established for presentation in the limitations data on the aircraft. The following explanation is set up on a chalkboard (fig. 1):

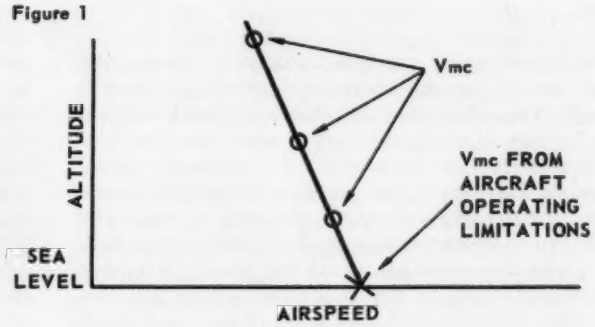
In later flights we have the pilot investigate Vmc at varying altitudes and establish his own curve for determination of the sea level value which would become controlling on the aircraft. We have found that the average pilot flying light twins has not previously had an explanation of this determination of Vmc and that the knowledge gained in such an explanation gives him a much better understanding of the safety procedures to be used in routine flight.



. . . and roof top landings

. . . FAA courses are designed to teach operating pilot how the aircraft's limitations were determined. . .

Figure 1



One of the questions invariably asked at this point is why Vmc is determined with gear *up*. Since everything else is set for takeoff—wing flaps, cowl flaps, and power—why is the gear retracted? The answer is that while this condition of low speed might occur in flight just after takeoff with the gear still down, it might also occur just a little later with the gear up—and this would be more critical, since the extended gear would have a stabilizing effect when the engine failed. In other words, this limitation, Vmc, is established in the most *critical condition*. Of course, it goes without saying that if the test pilot finds on a particular type of plane that the gear-down condition is most critical, the limitation is so established and this fact appears in the Airplane Flight Manual.

In our courses at the FAA Academy we naturally follow the establishment of Vmc with discussions and demonstrations of its significance. For instance, some of the very popular so-called light twins, and particularly the tail-wheel types, just naturally want to "sneak" off the ground below Vmc. Some planes, when put at just the right angle, will leave the ground a considerable number of mph low—and we have been flying them that way for years! There is a takeoff procedure, used for normal takeoffs by many light twin pilots, which goes as follows: Raise the nose wheel from the ground as you approach flying speed and, after takeoff, level off *just above the runway* and accelerate to Vmc.

When a plane is on the ground, the pilot has ground control, in the event of engine failure, through the use of steerable nose or tail wheels, brakes, etc. When it is in the air *above* Vmc, he has air control. So we question the logic of giving up ground control before getting to a speed at which air control is available in the event of engine failure. Of course, this procedure would be correct for takeoff from a rough or muddy field and we, too, would accept the calculated risk and use it—if we had to—but we would not teach it as the normal or standard procedure.

In our consideration of the minimum control speed and its significance to the pilot in flight, we point out that Vmc is, as its name suggests, a con-

ENGINEERING APPROACH TO LIGHT TWIN OPERATION

Cessna 310 is used for light twin work

trollability speed and is not necessarily in its safest relationship to the operational speeds of the aircraft. The safest possible condition would obviously be that in which the normal operating speeds of the aircraft were always above the minimum control speeds. Such is not the case. Our classes discuss and demonstrate the fact that Vmc speeds are normally *above* the speed for best angle of climb when both engines are operating at takeoff power. A typical example would be that of a plane whose best two-engine, angle-of-climb speed was 75 mph and whose Vmc was 85 mph. Such conditions are not unusual.

When the pilot takes off and climbs out over obstacles at this low speed, he will obviously obtain the steepest angle of climb possible. However, if an engine should fail under these conditions—10 mph or more below Vmc, and in a steep climbing attitude—he is immediately in *bad* trouble. Now we do not tell the student that he must *never* do this. We, too, would do it if circumstances forced us to—but our courses attempt to teach an understanding of the inherent dangers and to demonstrate how some planning might make the operation safer.

For instance, we set up a "sighting bar" to measure angles and heights and compare two types of takeoffs. With the bar set at one side of the runway and 1,500 feet from the start of takeoff, we have the student leave the ground and climb out of a theoretical field 1,500 feet long at best *angle* speed (below Vmc). Then he does the same thing leaving the ground at Vmc and climbing out just above that speed. The difference in height attained at 1,500 feet down the field is so slight as to be negligible. In fact, if that much difference were needed to clear the trees, I personally would take an extremely dim view of flying out of that field at all!

Since the students in the classes under discussion are normally themselves FAA general operations inspectors, they will be taking the information learned back into the field of the operation of general aviation aircraft. They will therefore be discussing these items with pilots who come to them for flight checks and/or operational information. With this in mind, we continually point out that the basic purpose for their learning limitations, control, and performance of aircraft is so they will be in a position to pass this knowledge on to others and thereby to give them *confidence* in their aircraft.

We do not consider this a contradiction. Actually, we strive at all times not to instill in our student a fear of the aircraft under normal operation but an understanding of its limits. We teach him to have a knowledge of the unsafe features of flight *outside* the envelope of established limitations, since we feel that such knowledge will give him additional confidence in the aircraft when he is flying it *within* this envelope. We caution him to always attempt to get this point over to the general operations pilots with whom he deals.

In the foregoing we have considered only controllability. In other words, we have been talking only of keeping the plane under control—not of actually flying it on out and around the field. As a matter of fact, there is nothing in the CAR governing either certification or operation of the light twins which says that they *must* fly with an engine out under such conditions as those discussed above. It is true that planes grossing more than 6,000 pounds, or having very high stalling speeds, must have a small amount of performance at 5,000 feet—and this same performance is called for in so-called air taxi operations. But even this small amount of climb is only called for with the plane completely "cleaned up" and at 5,000 feet in standard, smooth air.

This lack of requirement for performance in the emergency condition is the basic difference between transport category requirements and those covering the operation of general aircraft. Those aircraft normally operated on the scheduled airlines of the world are certificated in what is spoken of as "transport category." This is a certification and operation philosophy which requires that the aircraft be thoroughly tested so that its performance is completely determined and that engineering calculation set up the variations of this performance with all the variables likely to be encountered in operation.

Obviously, performance will decay when runways are at higher altitudes, when temperatures go up, when runways contain positive gradient, when the humidity is high, and when weights are greater than those permissible for existing conditions. Performance of an aircraft is a function of a number of variables, and this performance can be determined taking all these variables into account.

This represents the first of the three segments of the transport category philosophy, which is proper *testing*. The second portion of this concept is covered by *dispatching*. This means that the certificated dispatcher shall take into account the variables of performance developed in tests, together with the ambient conditions existing for the particular operation. By varying the permissible weight of the aircraft, as performance varies, he will guarantee that a required minimum level of safety will be met. The third portion of transport category philosophy is, obviously, *operation*. If dispatching is properly done, based upon testing which has been properly done, then operation necessarily must use the same techniques, procedures, and speeds used in testing. Otherwise, the level of safety inherent in transport category is negated.

General aircraft operation, on the other hand, does not attempt to maintain this high level of safety, since to do so would be economically unfeasible. The nontransport category aircraft can legally take off at gross weight at Miami, Chicago, Denver, or even at La Pas, Bolivia, 13,400 feet above sea level. With this fact in mind, it would appear that the normal takeoff procedure should envision the possibility of engine trouble and that the standard climbout path should be planned accordingly.

We have found that pilots tend to associate the performance of their aircraft with the conditions normally existing at their home field. We have found situations in which pilots, stationed at sea level, insisted that a certain type of light twin flew excellently on one engine; while other pilots, stationed at high altitudes, insisted that it did not. Interestingly enough, they did not appear to associate the performance of the aircraft with the conditions normally existing at its home base. We, of course, make a very strong point of the fact that ambient conditions will vary performance widely.

Another variable which we have found the average pilot to overlook is that of aircraft weight. We make a great point, both in lectures and flight demonstrations, of the effect of weight upon aircraft performance, particularly in the emergency condition. Pilots have received their certificates based upon a flight check conducted at low altitude in an aircraft without baggage, with tanks half full or less, and with only the student and the instructor or check pilot aboard. Having obtained this certificate, the pilot immediately becomes eligible to load this aircraft to its maximum weight and to take it to fields such as Albuquerque or Denver on the extremely hot days to be encountered there in summer, and to operate at gross loads under these conditions.

We point out that although this pilot may not be aware of it, in an emergency condition, he is actually flying *an entirely different aircraft* when performance has decayed to this extent. Because of his change of environment, he can no longer expect the aircraft to react in the same way that it did under the original conditions. These variations in environment and weight should obviously tend to vary his techniques, procedures, airspeeds, etc., during operation of the aircraft. In other words, he should change his *plans* to conform to the changed conditions.

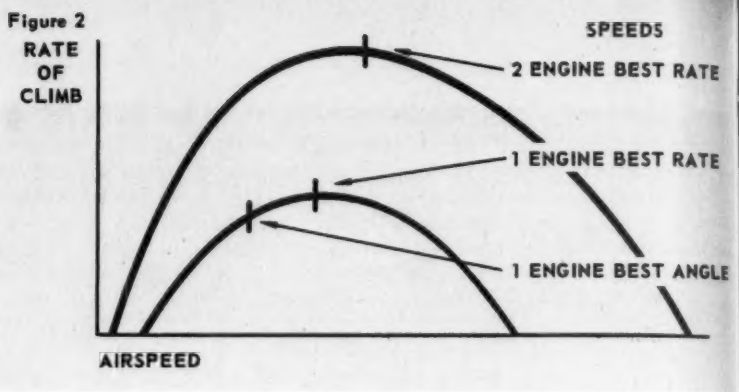
TAKEOFF PLANNING

By takeoff planning we do not mean any highly complicated procedure. We think rather in terms of just "using a little common sense." It's the same type of thinking that we "old timers" used with single engine planes 20 years ago. For instance, if you started cross-country and suddenly found a wide swamp with the pencil line on your map right down the middle of it for 15 miles, you didn't fly there just because the mark was there—you skirted the edge, in gliding distance of some fields, and cut across the swamp at a narrow point. Well, that same kind of thinking is what we mean.

A climbout path should, of course, be made so that you will miss all obstructions—but just what does that mean? In *our* thinking, anything between where you sit, at the takeoff end of the runway, *and getting back to that same place with an engine out is an obstruction*—and it should play its part in your planning! Obviously, such a concept means

ENGINEERING APPROACH TO LIGHT TWIN OPERATION

Figure 2



that each airport, being different, will demand some variation of your basic procedure.

An infinite number of takeoff and climbout procedures are available, so let's just analyze the extremes. First, how about the one in which we leave the ground, "hold her down," and go over the far end of the runway at cruising speed—or above—at 30 feet high? If we are going to admit the possibility of an engine failure somewhere in this procedure, it doesn't make much sense. Remember that the drag increases as the square of the speed, and the faster you are going, the greater the drag of that dead prop will be. We point out that the drag at 123 mph is one and one-half times what it is at 100, at 141 mph the drag has doubled, and at 200 mph the drag is four times that at 100 mph.

The pilot can suddenly discover that he has converted all the energy produced by those engines into speed, and that the speed deserts him immediately. Of course, there is the argument that you can use this speed to "zoom" up. But we find that an unexpected engine failure leaves the average pilot feeling like he is "swimming around in glue" for a few seconds. By the time he has control of the situation and is ready to use the speed, he finds himself down to about the speed at which he should have been all the time—but still at 30 feet! From this point, he will have to climb, with an engine out, to whatever height is needed to clear the obstructions at this particular field and get back to the end of a runway. And remember the old saying that "nothing will spoil your day like an *almost* takeoff."

In other words, we have found that speed cannot readily be converted to energy to help you around the field. On the other hand, a plane will fly level, under these conditions, far easier than it will climb. If, therefore, the energy of all engines has been converted into enough height above the field elevation to permit you to clear all obstructions in level flight, the problem is *much* simpler. Further, if some extra height is available, it *can* be traded for energy. This is the same reasoning that we always used for single engine planes. Indeed, we feel that the nontransport category twin engine takeoff might well be patterned after that found logical for single engine planes—except *don't fly below Vmc*. This concept worked out excellently in our C-46 course.

GETTING HEIGHT SAFELY

Having concluded that a certain amount of height, based upon local conditions, is desirable early in the takeoff climb, the procedure for getting it safely must be determined. Of course, a takeoff and climb *at best angle of climb speed* would get the most height in the shortest distance—but remember Vmc? Going to a climb speed well below Vmc would be trading the possibility of a high speed crash for an opportunity to practice spins at low altitude!

We recommend leaving the ground at, or slightly above Vmc, and climbing, with all engines going, at the *one-engine* climb speed. Remember that the engine-out, best-rate-of-climb speed will normally be well below the two-engine, best-rate speed. This procedure then will permit you to take on height with a minimum of forward distance. In other words, you are operating at a steeper angle of climb than would be possible at the two-engine, best-rate-of-climb speed.

Let's consider this recommendation for a moment. In case one engine fails at the engine-out, best-rate speed, complete control will normally be attained with the loss of a very few miles per hour. And since the one-engine best angle of climb speed normally lies a few miles per hour below the one-engine, best-rate speed, this should result in your continuing from the point of engine failure at approximately the best possible speed for obstruction clearance (see fig. 2).

An additional reason for climbing with all engines going at the engine-out, best-rate-of-climb speed is that this value is obtainable from the air-

plane flight manual, or from other data published on the airplane. This speed should be maintained until some predetermined altitude has been reached. Obviously, if the climb is prolonged and/or the weather is particularly hot, engine temperatures must also be taken into consideration. At our home base, Will Rogers World Airport, we are fortunate in having almost no high obstructions, yet the height we go to immediately after takeoff is 400 feet above the ground. At this point we ease the nose down and let the airspeed climb smoothly to best-rate-of-climb speed. Then, at the end of the maximum time permitted (usually one minute), we make the first power reduction. Our DC-3s and larger planes are flown the same way substituting V_1, V_2 speeds for Vmc and best climb speed.

Of course those light twins, operating at low altitudes and on extremely long runways, may find it unnecessary to take special precautions such as those noted above. Obviously, there is no need for climbing at a steep angle off a 10,000 foot runway in the midst of great unobstructed plains, particularly if the aircraft has outstanding performance, with all engines going, so that it assumes an unnaturally steep attitude. In such instances, we recommend varying the foregoing procedures to take into account the conditions which exist. But, after all, this is what we have been talking about all along. You should know something of the performance of your airplane. You should know its limitations. You should understand its controllability and its flight characteristics to the extent that you can consider these in light of the environment in which you find yourself. You can then vary your takeoff plan accordingly.

It is well known that human beings react in given situations in accordance with habits which have been established. We have further found that the pilot's reaction at the moment of emergency will be conditioned, quite strongly, by any plans which he has made or any consideration which he has given to emergency possibilities. For instance, if he has determined before takeoff that he will monitor the flight path and will take a certain specific action at a particular moment should he be in trouble, he will be prone to do this without thought—and without loss of time. We therefore attempt to establish in our students this philosophy of planning and of telling themselves what speeds and what procedures they would use at each particular regime of flight during takeoff and climbout from a particular field.

The knowledgeable pilot will readily admit in a general discussion that when the aircraft is heavily loaded or when the temperature and altitude are high, that an engine failure must result in a landing—and that he has no recourse except to pick out the "softest" place available to put it down. On the other hand, it is an entirely different thing to have this same pilot react smoothly and correctly when such an eventuality does occur. The first human reaction is to refuse to believe that such a thing can have happened—and to seek rather wildly to find out what has occurred and how he can keep the aircraft in the air.

Under extreme conditions, of course, it is necessary for the pilot to make his decision rapidly and to take proper action without delay. It has been our experience that if this man has told himself ahead of time the exact action which he will take under such circumstances, he will be prone to react in the proper manner and will therefore minimize the final results of the emergency which has occurred.

Up to this point, I have discussed some of the limitations, and some performance criteria, on light twin aircraft and the significance of the knowledge of these items to the general aircraft pilot. The courses through which we put our pilots also go into such subjects as stability, climb performance and use of flaps, the significance of weight and balance, the use of power, etc., and always we teach the airplane flight manual and the importance of "flying by the numbers." With the jet and turboprop age upon us, and the supersonic transport on the horizon—when even the light twins have pressurized cabins and radar for all-weather operation, the time of "flying by the seat of the pants" is gone; and the pilot who is content to be just a "throttle bender" is rapidly following.

The engineering type of knowledge required of today's pilot is far greater than that required of the pilot of only a few years ago. And the general aviation pilot who recognizes this fact and attempts to educate himself, rather than to fight progress, is the type of man who will do a better job of flying safely himself and of making the airways and the airports safer for everyone else.

As we tell our students from the operations field, we are not trying to make *complete* engineers of them. We only wish them to be "junior, assistant, associate" engineers. In other words, the engineering approach to the flying of such aircraft is essential in today's airspace. After all, those engineers who design, build, and test the aircraft have developed a vast amount of knowledge about it. Much of this has been set down in the form of markings, placards, and manuals. Much of it is available to the pilot in the form of stated limitations and performance data. It behooves him to learn the significance of this information so that he can take advantage of it in his day-by-day operation.

Who's In Charge Here?

PILOT: "THiS WAS my second day of transitioning in the U-1A. My instructor and I had flown an hour and 50 minutes the previous day, consisting of a local area checkout and several approaches.

"On this day, we had made 12 or 13 approaches. After each touchdown with full flaps, I pumped the flaps up to the climb position. On the last roll and takeoff, I had the flaps in climb position and was about one-third the way down the runway and about 25-50 feet in the air. I had set the power at 30 inches manifold pressure and 2200 rpm, then momentarily took my hand off the throttle and was looking forward to keep in line with the runway. All of a sudden, the engine cut off and I immediately reached for the throttle. I saw the IP's hand on it. I don't recall him saying forced landing, but since he had his hand on the throttle handle, I assumed he had control of it.

"I pushed the controls forward to set up a glide, then reached for the flap to add flaps, but the control lever was in the flaps up position, so I immediately pushed it down. The IP then added full power and I thought the aircraft would come out of its descent, so I didn't add more flaps immediately.

"The aircraft continued to descend and made a hard landing. We both had directional control but the aircraft veered to the right. I was afraid that if I added left rudder the right wheel would run over the runway light, so I just let the aircraft roll to the right. After the aircraft rolled to a stop, we shut off the switches and fuel and jumped out."

IP: "I initiated a simulated forced landing after takeoff. The aircraft was approximately 50 feet over the runway, airspeed 75 knots, and flaps in the climb position. About 3,000 feet of runway remained for the landing.

"The pilot eased the nose forward and the aircraft was in a position to glide in for a landing. At that time, the pilot began to bring the flaps up. I stopped him and applied power, but the nose had come up slightly and a rapid sink rate started. The

crash sense

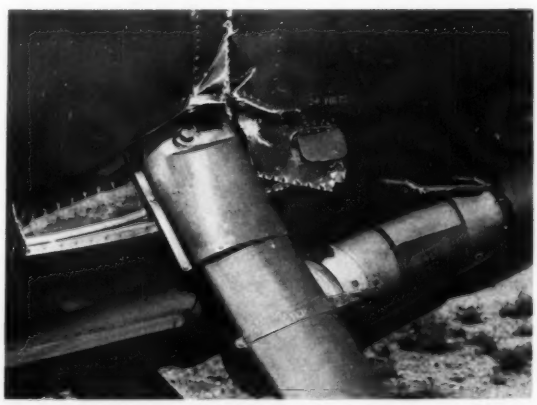
PREPARED BY THE U. S. ARMY BOARD FOR AVIATION ACCIDENT RESEARCH

aircraft struck in 3-point attitude with full power applied. The impact caused the right main gear to partially collapse and the aircraft veered to the right. I chopped the power and the pilot applied brakes. The aircraft came to a halt just to the right side of the runway."

Accident investigation board: "Prior to the accident, there was no apparent briefing or any understanding between the IP and pilot as to when the IP would take control of the aircraft. . . . The pilot's inexperience in the U-1A and the lack of understanding about aircraft control apparently added confusion in the cockpit. After the pilot recognized he had a simulated engine failure, he made an attempt to increase flaps, but the flap selector lever was in the flaps up position and he actually decreased flaps, causing the sink rate to increase. Had the flap selector lever been in the neutral position, as called for in the –10, there would have been no decrease in the flap setting."

The board recommended that IPs brief and give definite instructions about pilot duties and what is expected of pilots during simulated and actual engine failures before any operational instruction.

Numerous accidents and incidents have resulted during training flights because of confusion over which pilot has control. The Director of Safety, Ross Aviation, Fixed Wing Division, USAAVNS, published the following instructions to standardize their instructor pilots and student pilots:



Cockpit confusion about who had control led to hard landing, driving gear into fuselage

crash sense

When the instructor wants to take over the controls he will call you over the interphone and say, "I have it." You acknowledge by answering him over the interphone and saying, "Roger, you have it." Then you shake the stick and release the controls.

When the instructor wants you to take the controls he will call you over the interphone and say, "You have it." You acknowledge by answering him over the interphone and saying, "Roger, I have it." Then you take the controls and shake the stick.

At any time you have the controls and your instructor does not call you on the interphone and advise you otherwise, assume you are still in charge of the airplane and continue to fly it until he calls and tells you to get off the controls. Never release the controls, relax your control pressures or quit flying the airplane until you know beyond a doubt that the instructor has taken over.

Don't think he has it! KNOW he has it before you turn it loose.

Out of Time, Fuel, and Altitude

OV-1C pilot: "The flight was scheduled to start at 0500. I got there about 0430 and preflighted the aircraft. I called weather on the telephone and asked for the 0700 forecast. They gave me 600 scattered and 10 miles. I checked all the fluid reservoirs, primarily to make sure that I had two oil tanks at the proper level and a full main fuel cell. This was checked with a pen light and also by dipping my finger into it.

"I got in the left seat, started the engines, made the runup check, and taxied out. I took off at 0502. After takeoff, I remained at the field and made three practice ILS approaches. The weather was VFR at this time. . . .

"I then flew north to a town approximately 80 miles away, then south to a town southwest of the home field. I took an 065 radial out of the second town and proceeded until 0640 when the fuel low light came on. At this time, I turned toward the home field and flew directly to the omni.

"When the fuel low light came on, the totalizer indicated 470 pounds of fuel. The main tank gauge indicated 460 pounds of fuel. I checked my position by omni and was approximately 30 miles from the home field omni. Upon approaching the home field, I determined from the tower that it was IFR and was told to contact approach. I did and was cleared for an immediate ILS approach. I went to low cruise power and descended to 2,600 feet.

"I turned direct to the outer marker and passed it at 2,600 feet, proceeding outbound for one minute. I turned right to a heading of 285, holding this heading for 40 seconds, then turned 180° left to a heading of 105 and descended to 2,000 feet. I started to intercept the ILS center line and turned to the inbound heading of 060°.

"When I heard the marker beacon, I dropped the gear and 15° of flaps and visually checked that both my wheels were down. At this time I was centerlined on the localizer and on the glide path of the ILS, with the GCA monitor standing by.

"As I entered the clouds, no. 2 engine quit without any warning on any of the gauges. I swept the rpm and power levers forward, identified the dead engine as no. 2, feathered it, and notified the tower that I had lost an engine. I felt, however, I had no particular problem as the aircraft was light in weight and I was landing anyway.

"Approximately 10 seconds after no. 2 engine quit, the fuel pumps light lit up on the caution panel. At this time, the fuel totalizer read 150 pounds and the main tank pointer read between 160 and 180 pounds. As I broke out of the clouds, I was still on the glide path and center of the localizer, according to my instruments, and had the field in sight. At this point, no. 1 engine quit. I informed the tower of "Mayday" and that both engines had quit. At this point, I felt I was too low to eject. I also realized, approximately five seconds later, that I could not make the overrun short of the runway. It would have required an attempt to stretch my glide. Realizing this, I lowered the nose and selected a small open area for landing which looked like a harvested corn field. Just prior to landing, I stalled the aircraft in an effort to land with minimum forward speed. Prior to impact, I turned off all switches on the left eyebrow panel and jettisoned the canopy. The last thing I noticed in the airplane was the main tank pointer reading 160 pounds of fuel, totalizer 150 pounds, and the caution panel was lit up like a Christmas tree."

Impact with the ground sheared all three gears and the Mohawk slid for approximately 105 feet before coming to a halt 3/4 of a mile from the

runway. It was damaged beyond economical repair and the pilot sustained major injuries.

Investigation

"Based on the transmission of the pilot to the tower, the suspected cause of the accident was fuel starvation. At the crash site the accident board visually inspected the main fuel tank and no fuel was sighted. A stick was also inserted into the tank but no fuel was detected. As the aircraft was removed from the field, the ground was inspected for evidence of ruptured fuel cells or lines. No fuel leakage was found. The aircraft was then placed in a hangar and the entire fuel system checked with the following results:

"1. Approximately 2 gallons of fuel were found in puddles on the bottom of the main fuel tank.

"2. No holes, breaks, or leaks were found in the fuel tank, lines, or system.

"3. Both engine fuel control systems were checked and found to be within specification limits.

"4. The fuel gauge was checked. With an empty tank, the totalizer indicated 49 pounds remaining and the main tank fuel indicator read 149 pounds remaining. At 400 pounds actual tank fuel, the totalizer indicated 340 pounds and the pointer 535 pounds.

"5. The fuel flow meter systems were damaged in the crash and could not be calibrated.

". . . The pilot indicated on his local flight plan that he was going to fly for 2 hours and 15 minutes and that he had enough fuel on board to stay aloft for 2 hours and 45 minutes. . . .

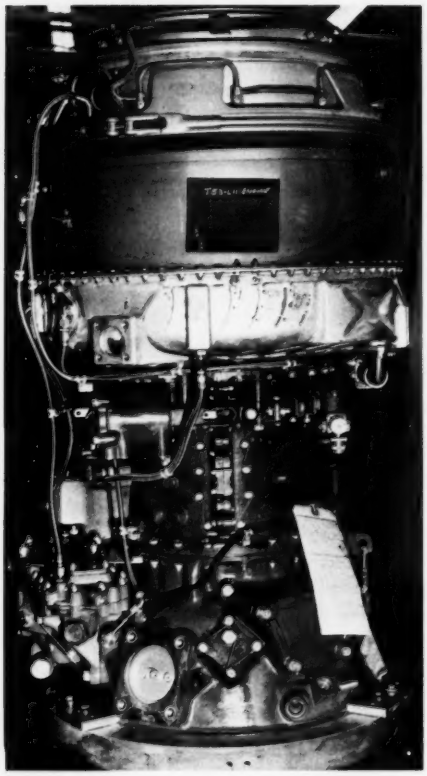
"Based on data listed in TM 55-1510-204-10, fuel requirements were calculated for the flight the pilot actually took, and the results indicated that he should have run out of fuel when he did. . . .

"The pilot stated that he feathered the no. 2 engine after it quit and that he turned off all switches before impact. All engine and fuel control switches were found on and neither propeller was feathered. The propeller control levers were fully forward in the unfeathered position. Further evidence that the propellers were rotating were lateral chops made in the ground by each propeller—three by no. 1 and five by no. 2. All six propeller blades were curled.

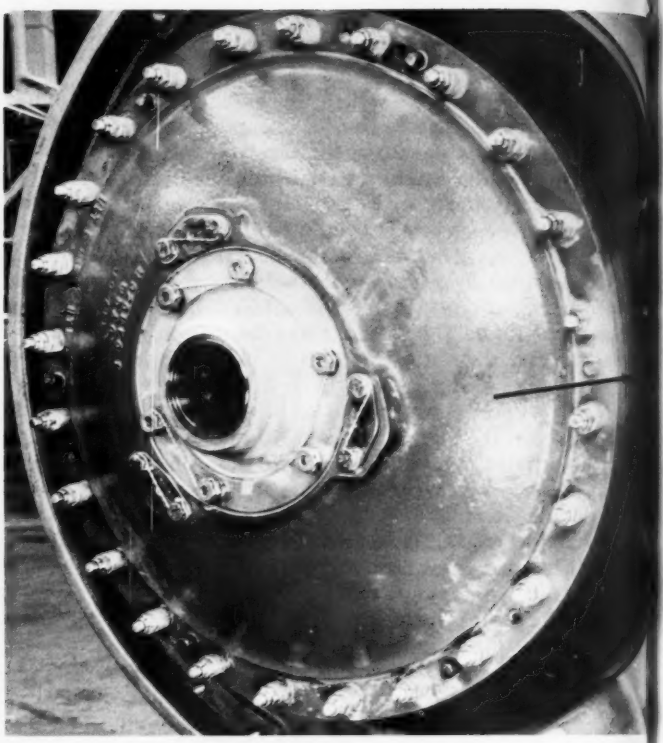
Analysis

". . . The pilot knew in his own mind that with 297 gallons of fuel he could fly for 2 hours and 15 minutes and land with the required fuel reserve. Throughout his flight, he never considered that this premise could be wrong. Consequently, when the 20 minute low level fuel warning light came on after approximately 1 hour and 40 minutes, he immediately surmised that the warning light was malfunctioning and that the fuel quantity pointer gauge, which proved to be reading high, was more nearly correct. If, at that point, he had prudently heeded the warning light and had notified approach control of his fuel condition, they could have cleared him for a straight in GCA and he would have made the field. Instead, he elected not to notify anyone of his warning light and accepted a standard ILS approach. Even when the no. 2 engine quit, the pilot told the board he thought he had engine failure and that he would bring the aircraft in with only one engine. It was not until the second engine quit that he believed his fuel was gone."

Aircraft came to rest in corn field 3/4 mile short of runway when pilot refused to believe low level fuel warning light



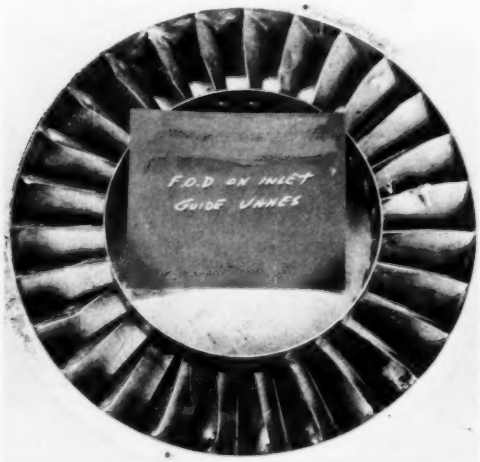
UH-1D engine was shipped to ARADMAC for teardown analysis because of high exhaust gas temperatures, low torque pressure readings, and damage to all compressor sections



Foreign object passed through inlet guide vanes

FOD

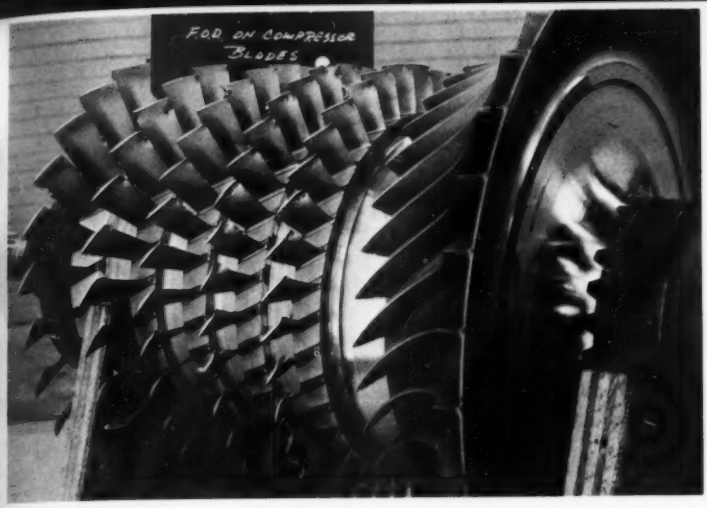
Foreign object was ingested into the air inlet housing



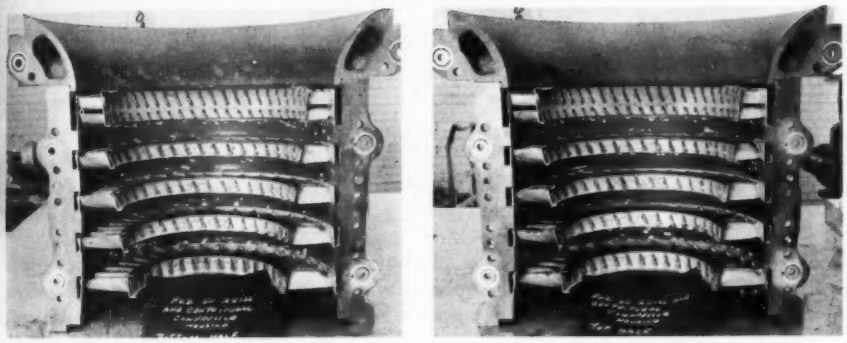
A T53-L-11 from a UH-1D helicopter was shipped to ARADMAC to determine the cause of foreign object damage to the compressor. Damage to this engine did not result in an accident, an incident, or a flight emergency. The engine was damaged and the damage was discovered while the aircraft was on the ground. Had this damage occurred in the air, the results may have proven far more serious.

Here is ARADMAC's report:

"Teardown of the engine revealed that a foreign object had been ingested into the air inlet housing and passed through the inlet guide vanes, axial and centrifugal compressor, stator vanes, and exit guide vanes. By the time the foreign object reached the N1 and N2 turbine wheels it was so small that



Compressor blades show damage from foreign object



Top and bottom halves of axial and centrifugal compressor housing show damage from foreign object

only nicks of a very minor nature were noted.

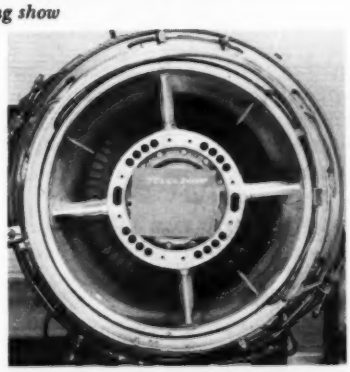
"Examination of the compressor revealed that some blades had the appearance of being struck by the threaded end, shank area, and head of a screw.

"Upon removal of the inlet guide vane assembly, microscopic examination revealed the imprint of an AN502 fillister head screw approximately 1/4" long on one of the vanes. This screw possibly came from some unknown position on the airframe and not from the engine.

"Upon removal of the air diffuser housing, a portion of the foreign object was found in one of the air passages. The metal object appeared to be a portion of the head of a screw. Microscopic examination revealed the crescent shaped area had failed from overload.

"High exhaust gas temperatures, low torque pressure readings, and damage to all compressor sections was caused by ingestion of a foreign object.

"Impact damage on the inlet guide vane and compressor rotor assemblies indicate that the foreign object was a fillister head screw approximately 1/4" in length."

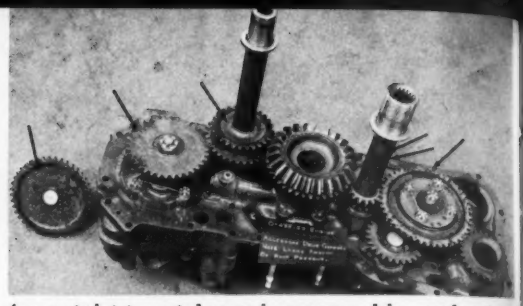


By the time the foreign object had reached the N1 and N2 turbine wheels, it was so small that only nicks of a very minor nature were noted

Impact damage on the inlet guide vane and compressor rotor assemblies indicated foreign object was a fillister head screw approximately 1/4" in length (similar screw is shown beside impact mark)

crash sense

Cause Undetermined



Arrows point to rusted areas in accessory drive gearbox from improperly preserved engine

OH-13S pilot: "I was assigned to fly an observer over the city. After one hour of flying, I felt the aircraft drop, as if caught in a downdraft. I noted the rpm starting to drop and I pushed the collective down a little and rolled on the throttle. The rpm continued to drop.

"I entered autorotation, informed my passenger that we had engine failure, and told him to lock his harness. I decided to attempt to touch down on an abandoned airfield in the west part of the city. My altitude at the time of failure was 800-1,000 feet.

"While in autorotation, I transmitted over the radio that I had engine failure and was going to land at the abandoned airfield.

"I did not believe I was going to be able to reach the touchdown area. I increased my airspeed to 80 knots to build up rpm, and proceeded to 'milk' the collective pitch to extend my glide. When I felt I had the area made, I started to decelerate at approximately 50 feet. I saw that I had 2900 rpm and high airspeed.

"I flared in an attempt to zero the airspeed and then leveled the aircraft for touchdown. When it touched, I still had a forward speed of about 10 knots. I was able to keep it straight on initial touchdown, but I had maximum collective pitch applied and full left pedal.

"The aircraft bounced forward after initial touchdown. On the second touchdown, it did a 180° turn to the left. When it stopped turning, I told my passenger to get out. . . ."

Accident board narrative: ". . . Cause of engine failure had not been established and the local maintenance unit had checked the engine as far as possible. There were no indications of ignition failure or contaminated fuel, but the engine was to be sent to ARADMAC for further analysis. . . .

"Cause Factors:

"a. Engine failure.

"b. Improper pilot technique. Pilot attempted to stretch glide, thus increasing rate of descent, then deteriorating rotor rpm resulted in lack of control responses.

"c. Lack of a suitable forced landing area in immediate vicinity forced pilot to select a landing area near the autorotation distance limit for the altitude.

"d. Pilot landed with 10-15 knot tailwind. Landing direction was dictated by landing area and distance. . . ."

Eight months after the accident, ARADMAC made its report of the teardown analysis. The long delay was due to failure of the reporting unit to follow the procedures given in Supply Letter 14-65, dated 16 February 1965, for teardown analysis of suspect parts. Because these procedures were not followed, the engine was routed for overhaul rather than analysis. When it was finally traced and sent to ARADMAC, its condition made it impossible to determine the cause of engine failure.

ARADMAC Report: "The engine was not properly preserved. The internal parts of the engine were covered with a considerable amount of rust and corrosion. The magnetos, ignition harnesses, and carburetor were not received with the engine.

"There was rust on the pistons, cylinder walls, hydraulic tappet bodies, magneto drive shaft, and all gears in the accessory drive section.

"The spark plugs were all in a serviceable condition. The plugs from number six cylinder were rusty and the cavity between the insulator and plug body was filled with deposit which had flaked off the inside of the cylinder and piston.

"The intake and exhaust valves in number one cylinder were leaking slightly.

"There was a large amount of combustion products present in all the cylinders and on the pistons. . . . The general chemical makeup of the products analyzed and the condition of the base metal indicates that the excessive buildup of the deposits on the pistons and in the cylinders was a result of normal combustion and the subsequent corrosion which was initiated by the presence of moisture in the cylinders.

"No discrepancies were found which could have contributed to a loss of power or failure of the engine. . . .

". . . Recommend the using activity be advised of damage incurred to this engine as a result of improper preservation."

Announcing

Army Aviation School Nonresident Instruction

RECENTLY, HEADQUARTERS, USCONARC granted the U.S. Army Aviation School authority to prepare and administer a number of courses to be offered by extension. Before this approval, the Aviation School nonresident courses were administered by the U. S. Army Artillery and Missile School at Fort Sill, Okla. Unless an individual knew this, or stumbled across the information in the USAAMS portion of DA Pamphlet 350-60, "Army Extension Program," he had no way of knowing these courses were available.

The number of courses now available is small, but the figure will be increased during the coming year. DA Pamphlet 350-60 is under revision. When published this pamphlet will list Army Aviation extension courses in a separate section.

Right now, the following courses are available:

Special extension course: *Flight Training Preparatory Course*

This special course consists of 3 subcourses containing 20 lessons, 3 examinations, and 27 credit hours. Its purpose is to provide initial entry flight training students with a common background knowledge of Army aircraft and principles of flight, weather, and map reading.

Regular extension courses:

AVN 2—*Employment of Army Aviation*

Introduction to Army Aviation; mission capabilities; organizational structure of divisional aviation; tactical employment of Army aircraft; airplane and helicopter landing areas; night operations; special operations; helicopter armament.

Nine lessons and examination—19 credit hours

AVN 3—*Army Aircraft and Principles of Flight*

Family of Army aircraft and their employment; training helicopters; basic aerodynamics; helicopter aerodynamics; basic helicopter flight training; inspections and forms; basic radio voice procedures.

Seven lessons and examination—10 credit hours

AVN 4—*Weather Elements*

Atmosphere and temperature; moisture; pressure and wind; weather hazards to flight; air mass weather; frontal weather.

Six lessons and examination—9 credit hours

AVN 50—*Organization Aircraft Maintenance (Supervisors)*

Maintenance management and functions; the supply system; materiel readiness; technical publications (two parts; organizational aircraft maintenance practices.)

Seven lessons and examination—28 credit hours

AVN 75—*Map Reading*

Course requirements; military symbols used on maps; military grid reference system; directions; orienting a map; contours and profiles; slope.

Seven lessons (programed text) and examination—8 credit hours

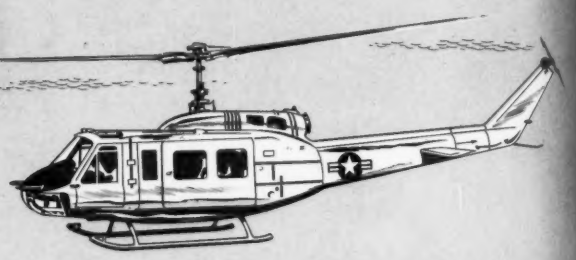
All military and eligible civilian personnel who are interested in taking one or more of these courses are encouraged to do so by writing

Commandant, USAAVNS
ATTN: AASPI
Fort Rucker, Alabama 36360

In your request indicate the course title and number (if appropriate) and your complete return address.

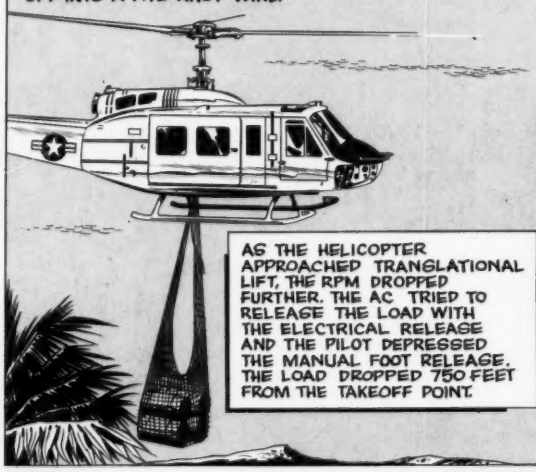
WEIGHT AND BALANCE

PREPARED BY THE U. S. ARMY BOARD FOR AVIATION ACCIDENT RESEARCH



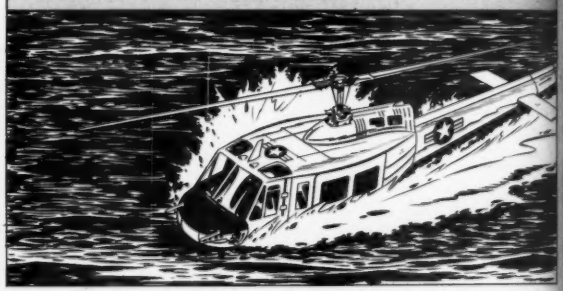
WITH AN AIRCRAFT COMMANDER, PILOT, CREWCHIEF, GUNNER, PASSENGER, AND 363 LBS. OF GEAR ABOARD A UH-1D TOOK OFF TO SLING LOAD FOUR 55 GAL. DRUMS OF JP-4 FUEL TO A POINT ONE-HALF MILE TO THE WEST.

THE AC HOVERED OVER THE LOAD WHILE THE CARGO NET WAS ATTACHED. HE THEN LIFTED THE LOAD AND HIS RPM DROPPED FROM 6700 AND STABILIZED AT 6400. HE TOOK OFF INTO A FIVE KNOT WIND.

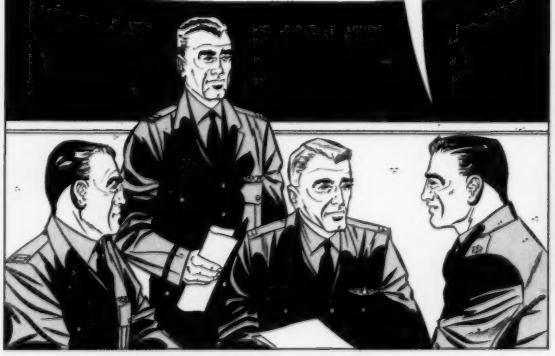


AS THE HELICOPTER APPROACHED TRANSLATIONAL LIFT, THE RPM DROPPED FURTHER. THE AC TRIED TO RELEASE THE LOAD WITH THE ELECTRICAL RELEASE AND THE PILOT DEPRESSED THE MANUAL FOOT RELEASE. THE LOAD DROPPED 750 FEET FROM THE TAKEOFF POINT.

CONTINUING INTO THE WIND, THE HELICOPTER REACHED A MAXIMUM ALTITUDE OF 40-50 FEET, WITH AN AIRSPEED OF 30-40 KNOTS. THE AC TURNED LEFT AS HE REACHED THE SHORE LINE OF A BAY. WITH LOW RPM AND A QUARTERING TAILWIND, FURTHER FLIGHT BECAME IMPOSSIBLE. THE HUEY HIT THE WATER IN A LEFT CRAB, LEFT-SKID-LOW ATTITUDE WITH AN ESTIMATED FORWARD SPEED OF 10-15 KNOTS. IT ROLLED OVER AND CAME TO REST INVERTED IN THREE FEET OF WATER 25 FEET FROM THE SHORE. THREE OCCUPANTS HAD MINOR INJURIES. THE OTHERS ESCAPED INJURY, BUT THE HELICOPTER WAS A TOTAL LOSS.



"WE FIND THE PRIMARY CAUSE OF THIS ACCIDENT TO BE FAILURE TO MAINTAIN ADEQUATE OPERATING RPM. CONTRIBUTING FACTORS WERE OPERATING 872 POUNDS IN EXCESS OF MAXIMUM GROSS WEIGHT LIMITATIONS; AIRCRAFT COMMANDER'S INEXPERIENCE WITH SLING LOAD EMERGENCY PROCEDURES; EXCESSIVE PERSONNEL ON BOARD THAT WERE NOT REQUIRED FOR THE MISSION; AND OPERATING OUT OF FORWARD CENTER OF GRAVITY LIMITATIONS BY TWO INCHES."



"...THE BOARD IMPLIED THROUGHOUT THEIR INVESTIGATION THAT THERE WERE SUPERVISORY FACTORS INVOLVED IN THIS ACCIDENT. THE FLIGHT SURGEON'S CONCLUSIONS STATE THAT TWO OF THE CONTRIBUTING FACTORS ARE SUPERVISORY. YET THE BOARD, IN THEIR FINDINGS, DO NOT MENTION SUPERVISORY FACTORS. THIS HEADQUARTERS CONSIDERS SUPERVISORY ERROR WAS A MAJOR CONTRIBUTING FACTOR IN THIS ACCIDENT IN THAT THE UNIT COMMANDER: 1. ALLOWED THE PILOT TO OPERATE AN AIRCRAFT WITHOUT COMPLETING A CHECK-OUT EITHER IN NORMAL OPERATIONS OR WITH SLING LOADS. 2. FAILED TO ESTABLISH GUIDE LINES FOR SLING LOADS WITHIN HIS ORGANIZATION..."